SCXI™

SCXI-1102/B/C User Manual

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Conventions

The following conventions are used in this manual:

<> — Angle brackets that contain numbers separated by an ellipsis represent a range of values associated with a bit or signal name—for example, AO <3..0>.

» — The » symbol leads you through nested menu items and dialog box options to a final action. The sequence **File»Page Setup»Options** directs you to pull down the **File** menu, select the **Page Setup** item, and select **Options** from the last dialog box.

— This icon denotes a note, which alerts you to important information.

— This icon denotes a caution, which advises you of precautions to take to avoid injury, data loss, or a system crash. When this icon is marked on the product, refer to the *Read Me First: Safety and Radio-Frequency Interference* document, shipped with the product, for precautions to take.

— When symbol is marked on a product it denotes a warning advising you to take precautions to avoid electrical shock.

— When symbol is marked on a product it denotes a component that may be hot. Touching this component may result in bodily injury.

bold — Bold text denotes items that you must select or click in the software, such as menu items and dialog box options. Bold text also denotes parameter names.

italic — Italic text denotes variables, emphasis, a cross-reference, or an introduction to a key concept. Italic text also denotes text that is a placeholder for a word or value that you must supply.

`monospace` — Text in this font denotes text or characters that you should enter from the keyboard, sections of code, programming examples, and syntax examples. This font is also used for the proper names of disk drives, paths, directories, programs, subprograms, subroutines, device names, functions, operations, variables, filenames, and extensions.

`monospace bold` — Bold text in this font denotes the messages and responses that the computer automatically prints to the screen. This font also emphasizes lines of code that are different from the other examples.

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1

About the SCXI-1102/B/C

This chapter introduces the SCXI-1102/B/C module, and explains how to install and remove the software and hardware.

The SCXI-1102/B/C modules are for signal conditioning of thermocouples, low-bandwidth volt and millivolt sources, 4 to 20 mA current sources, and 0 to 20 mA process-current sources. When used with the SCXI-1581 precision current source module, you can use the SCXI-1102/B/C to measure RTDs and thermistors. The SCXI-1102/B/C has 32 differential analog input channels and one cold-junction sensor channel. Each channel also has an amplifier with a selectable gain of 1 or 100. You can multiplex the SCXI-1102/B/C inputs to a single output, which drives a single DAQ device channel.

On each channel the modules have the following:

- SCXI-1102—a two-pole lowpass filter with a 2 Hz cutoff frequency to reject 60 Hz noise.
- SCXI-1102B—a three-pole lowpass filter with a 200 Hz cutoff frequency.
- SCXI-1102C—a three-pole lowpass filter with a 10 kHz cutoff frequency.

You can multiplex several SCXI-1102/B/C modules and other SCXI modules into a single channel on the DAQ device, greatly increasing the number of analog input signals that you can digitize.

Detailed specifications of the SCXI-1102/B/C modules are listed in Appendix A, *Specifications*.

What You Need to Get Started

To set up and use the SCXI-1102/B/C module, you need the following:

- ❑ Hardware
  - At least one of the following modules:
    - SCXI-1102
    - SCXI-1102B
    - SCXI-1102C
  - At least one of the following terminal blocks:
    - SCXI-1300
    - SCXI-1303
    - SCXI-1308
    - SCXI-1310
    - TC-2095
    - TBX-1303
    - TBX-96
  - An SCXI chassis or PXI/SCXI combination chassis
  - One of the following:
    - E/M Series DAQ device
    - SCXI-1600
  - A computer if using an SCXI chassis
  - Cabling, cable adapter, and sensors as required for your application
- ❑ Software
  - NI-DAQ
  - One of the following software packages:
    - LabVIEW
    - Measurement Studio
    - LabWindows™/CVI™

- ❑ Documentation
  - – *Read Me First: Safety and Radio-Frequency Interference*
  - – *DAQ Getting Started Guide*
  - – *SCXI Quick Start Guide*
  - – SCXI-1102/B/C User Manual
  - – Terminal block installation guide for your application
  - – Documentation for your software

National Instruments Documentation

The SCXI-1102/B/C User Manual is one piece of the documentation set for data acquisition (DAQ) systems. You could have any of several types of manuals depending on the hardware and software in the system. Use the manuals you have as follows:

- SCXI chassis or PXI/SCXI combination chassis manual—Read this manual for maintenance information on the chassis and for installation instructions.
- The *DAQ Getting Started Guide*—This document has information on installing NI-DAQ and the E/M Series DAQ device. Install these before you install the SCXI module.
- The *SCXI Quick Start Guide*—This document contains a quick overview for setting up an SCXI chassis, installing SCXI modules and terminal blocks, and attaching sensors. It also describes setting up the SCXI system in MAX.
- The SCXI hardware user manuals—Read these manuals next for detailed information about signal connections and module configuration. They also explain, in greater detail, how the module works and contain application hints.
- Accessory installation guides or manuals—Read the terminal block and cable assembly installation guides. They explain how to physically connect the relevant pieces of the system. Consult these guides when you are making the connections.
- The E/M Series DAQ device documentation—This documentation has detailed information about the E/M Series DAQ device that plugs into or is connected to the computer. Use this documentation for hardware installation and configuration instructions, specification information about the E/M Series DAQ device, and application hints.

- Software documentation—You may have both application software and NI-DAQ software documentation. National Instruments (NI) application software includes LabVIEW, LabWindows/CVI, and Measurement Studio. After you set up the hardware system, use either your application software documentation or the NI-DAQ documentation to help you write your application. If you have a large, complex system, it is worthwhile to look through the software documentation before you configure the hardware.
- One or more of the following help files for software information:
  - **Start»Programs»National Instruments»NI-DAQ» NI-DAQmx Help**
  - **Start»Programs»National Instruments»NI-DAQ» Traditional NI-DAQ User Manual**
  - **Start»Programs»National Instruments»NI-DAQ» Traditional NI-DAQ Function Reference Help**

You can download NI documents from `ni.com/manuals`. To download the latest version of NI-DAQ, click **Download Software** at `ni.com`.

Installing Application Software, NI-DAQ, and the DAQ Device

Refer to the *DAQ Getting Started Guide* packaged with the NI-DAQ software to install your application software, NI-DAQ driver software, and the E/M Series DAQ device to which you will connect the SCXI-1102/B/C. NI-DAQ 7.0 or later is required to configure and program the SCXI-1102/B/C module. If you do not have NI-DAQ 7.0 or later, you can either contact a NI sales representative to request it on a CD or download the latest NI-DAQ version from `ni.com`.

Note Refer to the *Read Me First: Safety and Radio-Frequency Interference* document before removing equipment covers or connecting or disconnecting any signal wires.

Installing the SCXI-1102/B/C Module into the SCXI Chassis

Refer to the *SCXI Quick Start Guide* to install the SCXI-1102/B/C module.

Connecting the SCXI-1102/B/C in an SCXI Chassis to an E/M Series DAQ Device for Multiplexed Scanning

Refer to the *SCXI Quick Start Guide* to install the cable adapter and connect the SCXI modules to the E/M Series DAQ device.

If you have already installed the appropriate software, refer to Chapter 3, *Configuring and Testing*, to configure the SCXI-1102/B/C module(s).

Connecting the SCXI-1102/B/C in a PXI/SCXI Combination Chassis to an E/M Series DAQ Device for Multiplexed Scanning

Refer to the *SCXI Quick Start Guide* to connect the SCXI modules to the E/M Series DAQ device.

If you have already installed the appropriate software, refer to Chapter 3, *Configuring and Testing*, to configure the SCXI-1102/B/C module(s).

Verifying the SCXI-1102/B/C Installation in Software

Refer to the *SCXI Quick Start Guide* for information on verifying the SCXI installation.

Installing SCXI Using NI-DAQmx in Software

Refer to the *SCXI Quick Start Guide* for information on installing modules using NI-DAQmx in software.

Manually Adding Modules in NI-DAQmx

If you did not auto-detect the SCXI modules, you must manually add each of the modules. Refer to the *SCXI Quick Start Guide* to manually add modules.

Note NI recommends auto-detecting modules for the first time configuration of the chassis.

Installing SCXI Using Traditional NI-DAQ (Legacy) in Software

Refer to the *SCXI Quick Start Guide* for information on installing modules using Traditional NI-DAQ (Legacy) in software.

Manually Adding Modules in Traditional NI-DAQ (Legacy)

If you did not auto-detect the SCXI modules, you must manually add each of the modules. Refer to the *SCXI Quick Start Guide* to manually add modules.

Note NI recommends auto-detecting modules for the first time configuration of the chassis.

Verifying and Self-Testing the Installation

The verification procedure for the SCXI chassis is the same for both NI-DAQmx and Traditional NI-DAQ (Legacy). To test the successful installation for the SCXI chassis, refer to the *SCXI Quick Start Guide.* Verify that the chassis is powered on and correctly connected to an E/M Series DAQ device.

After verifying and self-testing the installation, the SCXI system should operate properly with your ADE software. If the test did not complete successfully, refer to Chapter 3, *Configuring and Testing*, for troubleshooting steps.

Troubleshooting the Self-Test Verification

If the self-test verification did not verify the chassis configuration, complete the steps in this section to troubleshoot the SCXI configuration.

Troubleshooting in NI-DAQmx

- If you get a **Verify SCXI Chassis** message box showing the SCXI chassis model number, **Chassis ID: *x***, and one or more messages stating **Slot Number: *x* Configuration has module: SCXI-*XXXX*** or **1102/B/C, hardware in chassis is: Empty**, take the following troubleshooting actions:
  - Make sure the SCXI chassis is powered on.
  - Make sure all SCXI modules are properly installed in the chassis. Refer to the *SCXI Quick Start Guide* for proper installation instructions.
  - Make sure the cable between the SCXI chassis and E/M Series DAQ device is properly connected.
  - Inspect the cable connectors for bent pins.

  - Make sure you are using the correct NI cable assembly.
  - Test the E/M Series DAQ device to verify it is working properly. Refer to the E/M Series DAQ device help file for more information.

- If you get a **Verify SCXI Chassis** message box showing the SCXI chassis model number, **Chassis ID: *x***, and the message **Slot Number: *x* Configuration has module: SCXI-*XXXX*** or **1102/B/C, hardware in chassis is: SCXI-*YYYY***, **1102/B/C**, or **Empty**, complete the following troubleshooting steps to correct the error.
  1. Expand the list of NI-DAQmx devices by clicking the **+** next to **NI-DAQmx Devices**.
  2. Right-click the SCXI chassis and click **Properties** to load the chassis configurator.
  3. Under the **Modules** tab, ensure that the cabled module is listed in the correct slot.
  4. If the cabled module is not listed in the correct slot, complete the following troubleshooting steps:
     a. If the cabled module is not listed in the correct slot and the slot is empty, click the drop-down listbox next to the correct slot and select the cabled module. Configure the cabled module following the steps listed in the *SCXI Quick Start Guide*. Click **OK**.
     b. If another module appears where the cabled module should be, click the drop-down listbox next to the correct slot and select the cabled module. A message box appears asking you to confirm the module replacement. Click **OK**. Configure the cabled module following the steps listed in the *SCXI Quick Start Guide*. Click **OK**.
- If you have more than one kind of SCXI module in the SCXI chassis, ensure that you have the highest priority SCXI module cabled to the E/M Series DAQ device. Refer to the *SCXI Quick Start Guide* to find out which SCXI module in the chassis should be cabled to the E/M Series DAQ device.
- After checking the preceding items, return to the *Troubleshooting the Self-Test Verification* section and retest the SCXI chassis.

If these measures do not successfully configure the SCXI system, contact NI. Refer to the *Technical Support Information* document for contact information.

Troubleshooting in Traditional NI-DAQ (Legacy)

- If you get the message **`Unable to test chassis at this time`**, you have not designated at least one module as connected to a E Series DAQ device. Refer to the *Traditional NI-DAQ (Legacy)* section of Chapter 3, *Configuring and Testing*, and change the configuration of the cabled module in the system from **Connected to: None** to **Connected to: Device *x***.
- If you get the message **`Failed to find`** followed by the module codes and the message **`Unable to communicate with chassis`**, take the following troubleshooting actions:
  - Make sure the SCXI chassis is powered on.
  - Make sure the cable between the SCXI chassis and E Series DAQ device is properly connected.
  - Inspect the cable connectors for bent pins.
  - Make sure you are using the correct NI cable assembly.
  - Test the E Series DAQ device to verify it is working properly. Refer to the E Series DAQ device help file for more information.
- If you get the message **`Failed to find`**, followed by module codes and the message **`Instead found: module with ID 0Xxx`**, refer to the *Traditional NI-DAQ (Legacy)* section of Chapter 3, *Configuring and Testing*, and make sure the correct module is in the specified slot. Delete the incorrect module as described in Appendix C, *Removing the SCXI-1102/B/C*, and add the correct module as described in the *Traditional NI-DAQ (Legacy)* section of Chapter 3, *Configuring and Testing*.
- If you get the message **`Failed to find`**, followed by a module code and the message **`Slot x is empty`**, make sure the configured module is installed in the specified slot. If not, install the module by following the instructions in the *SCXI Quick Start Guide*. If the module is installed in the correct slot, power off the chassis, remove the module as specified in Appendix C, *Removing the SCXI-1102/B/C*, and verify that no connector pins are bent on the rear signal connector. Reinstall the module as described in the *SCXI Quick Start Guide*, ensuring the module is fully inserted and properly aligned in the slot.
- After checking the preceding items, return to the *Troubleshooting the Self-Test Verification* section and retest the SCXI chassis.

If these measures do not successfully configure the SCXI system, contact NI. Refer to the *Technical Support Information* document for contact information.

2

Connecting the Signals

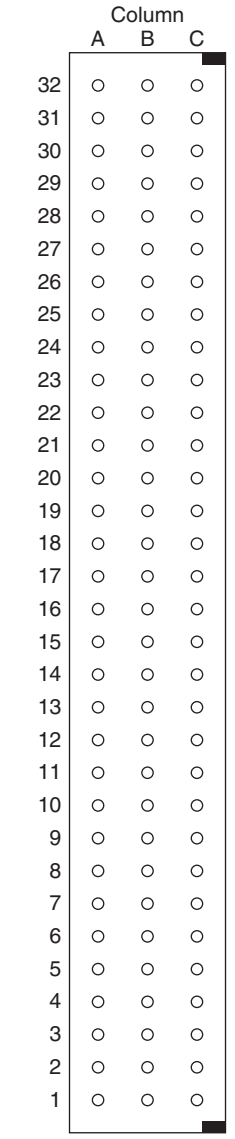
This chapter describes the input and output signal connections to the SCXI-1102/B/C module with the module front connector and rear signal connector. This chapter also includes connection instructions for the signals on the SCXI-1102/B/C module connectors.

Refer to the installation guide of the terminal block for detailed information regarding connecting the signals. If you are using a custom cable or connector block, refer to the *Front Connector* section.

Front Connector

Table 2-1 shows the pin assignments for the SCXI-1102/B/C module front connector.

Table 2-1. SCXI-1102/B/C Front Signal Pin Assignments

Front Connector Diagram	Pin Number	Column A	Column B	Column C
	32	CH GND	AI 0 –	AI 0 +
	31	NC	AI 1 –	AI 1 +
	30	NC	AI 2 –	AI 2 +
	29	NC	AI 3 –	AI 3 +
	28	NC	AI 4 –	AI 4 +
	27	NC	AI 5 –	AI 5 +
	26	NC	AI 6 –	AI 6 +
	25	NC	AI 7 –	AI 7 +
	24	CH GND	AI 8 –	AI 8 +
	23	NC	AI 9 –	AI 9 +
	22	NC	AI 10 –	AI 10 +
	21	NC	AI 11 –	AI 11 +
	20	NC	AI 12–	AI 12 +
	19	NC	AI 13 –	AI 13 +
	18	NC	AI 14 –	AI 14 +
	17	NC	AI 15 –	AI 15 +
	16	CH GND	AI 16 –	AI 16 +
	15	NC	AI 17 –	AI 17 +
	14	NC	AI 18 –	AI 18 +
	13	NC	AI 19 –	AI 19 +
	12	NC	AI 20 –	AI 20 +
	11	NC	AI 21 –	AI 21 +
	10	NC	AI 22 –	AI 22 +
	9	NC	AI 23 –	AI 23 +
	8	NC	AI 24 –	AI 24 +
	7	NC	AI 25 –	AI 25 +
	6	NC	AI 26 –	AI 26 +
	5	CH GND	AI 27 –	AI 27 +
	4	CJ SENSOR	AI 28 –	AI 28 +
	3	CJ SENSOR	AI 29 –	AI 29 +
	2	CH GND	AI 30 –	AI 30 +
	1	+5 V	AI 31 –	AI 31 +

NC—No Connection

Front Connector Signal Descriptions

Table 2-2. Front Connector Signals

Pin	Signal Name	Description
A1	+5 V	+5 VDC Source—Used to power the temperature sensor on the terminal block. 0.2 mA of source not protected.
A2, A5, A16, A24, A32	CH GND	Chassis Ground—Tied to the SCXI chassis.
A3, A4	CJ SENSOR	Cold-junction Temperature Sensor Input—Connects to the temperature sensor of the terminal block.
B1–B32	AI 31 – through AI 0 –	Negative Input Channels—Negative side of differential input channels.
C1–C32	AI 31 + through AI 0 +	Positive Input Channels 31 through 0—Positive side of differential input channels.
Note: All other pins are not connected.		

Analog Input Signal Connections

The signal terminals for the negative input channel are located in column B of the connector. The signal terminal for each corresponding positive input channel is located in column C of the connector. Each input goes to a separate filter and amplifier that is multiplexed to the module output buffer. If the terminal block has a temperature sensor, the sensor output—connected to pins A3 and A4 (CJ SENSOR)—is also filtered and multiplexed to the module output buffer.

The differential input signal range of an SCXI-1102/B/C module input channel is ±10 V when using a gain of 1 or ±0.1 V when using a gain of 100. This differential input range is the maximum measurable voltage difference between the positive and negative channel inputs. The common-mode input signal range of an SCXI-1102/B/C module input channel is ±10 V. This common-mode input range for either positive or negative channel input is the maximum input voltage that results in a valid measurement. Each channel includes input protection circuitry to withstand the accidental application of voltages up to ±42 VAC peak or 60 VDC.

Cautions Exceeding the input damage level (±42 VAC peak or 60 VDC between input channels and chassis ground) can damage the SCXI-1102/B/C module, the SCXIbus, and the DAQ device. NI is *not* liable for any injuries resulting from such signal connections.

Applying a voltage greater than ±42 VAC peak or 60 VDC to the SCXI-1102/B/C is an electrical shock hazard. NI is *not* liable for any damages or injuries resulting from such voltage application.

Note Exceeding the differential or common-mode input channel ranges results in a distorted signal measurement, and can also increase the settling time requirement of the connected E/M Series DAQ device.

Ground-Referencing the Signals

The input signals can be either ground-referenced, as shown in Figure 2-1, or floating, as shown in Figure 2-2. Before you connect the thermocouple or any other signal, determine whether it is floating or ground-referenced. If it is a floating signal, you must ground-reference the signal in one of two ways. You can connect the negative channel input to chassis ground through a bias resistor as shown in Figure 2-2 or you can use the bias resistors that are included with some terminal blocks such as the SCXI-1303. The SCXI-1303 also has a resistor pack for pulling up the positive inputs for open-thermocouple detection. Consult the installation guide of your terminal block for details.

Do not ground signals that are already ground-referenced; doing so results in a ground loop, which adversely affects the measurement accuracy. Directly grounding floating signals to the chassis ground without using a bias resistor is not recommended as this can result in noisy readings.

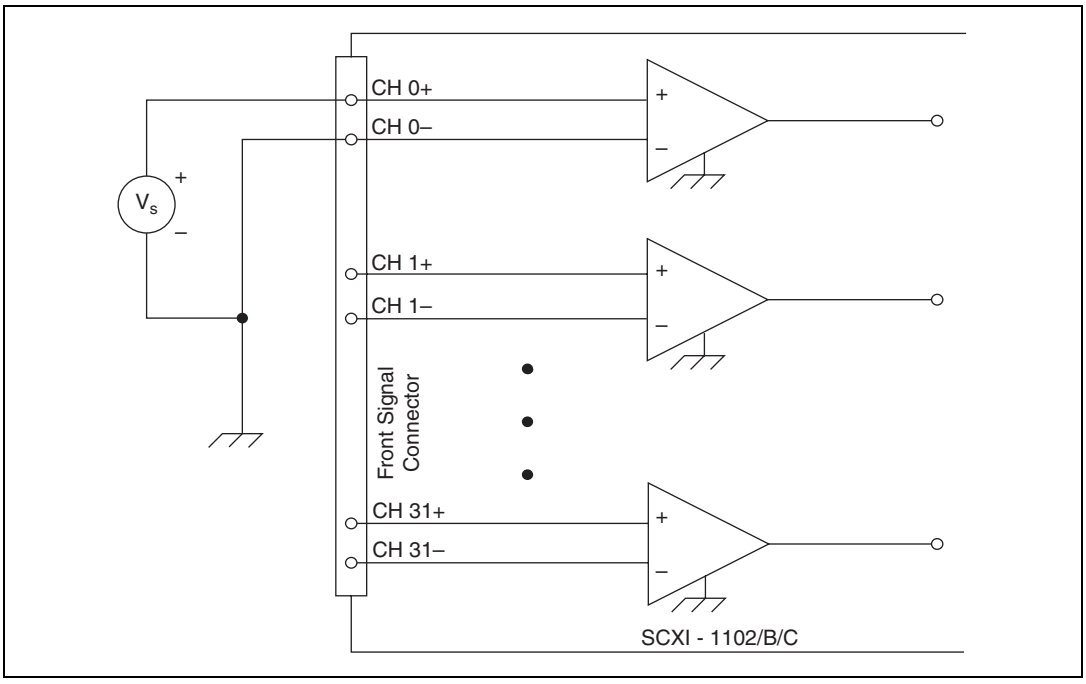


Figure 2-1. Ground-Referenced Signal Connection

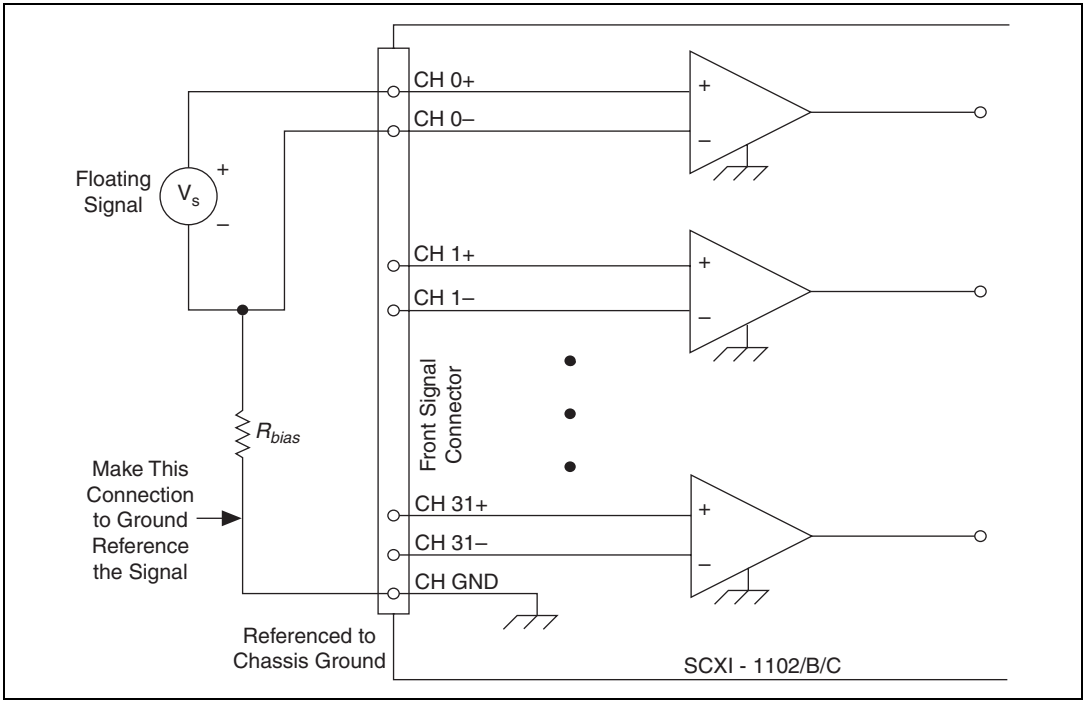


Figure 2-2. Floating Signal Connection Referenced to Chassis Ground

Cold-Junction Sensor Connection

Pins A3 and A4 (CJ SENSOR) connect the temperature sensor located on the SCXI-1300 or SCXI-1303 terminal blocks to the SCXI-1102/B/C module. The CJ SENSOR signal is measured relative to CH GND. Pins A3 and A4 are connected within the SCXI-1102/B/C module so the position of the *MTEMP*/*DTEMP* jumper on the SCXI-1300 or SCXI-1303 does *not* matter. The input is overvoltage-protected to 15 VDC with power on and off.

Caution Exceeding the overvoltage protection on the CJ SENSOR input can damage the SCXI-1102/B/C module, the SCXIbus, and the DAQ device. NI is *not* liable for any damages or injuries resulting from such signal connections.

Rear Signal Connector

Table 2-3 shows the SCXI-1102/B/C module rear signal connector pin assignments.

Table 2-3. Rear Signal Pin Assignments

Rear Connector Diagram	Signal Name	Pin Number	Pin Number	Signal Name
	AI GND	1	2	AI GND
	CH 0 +	3	4	CH 0 –
	NC	5	6	NC
	NC	7	8	NC
	NC	9	10	NC
	NC	11	12	NC
	NC	13	14	NC
	NC	15	16	NC
	NC	17	18	NC
	OUT REF	19	20	NC
	NC	21	22	NC
	NC	23	24	D GND
	SER DAT IN	25	26	SER DAT OUT
	DAQ D*/A	27	28	NC
	SLOT 0 SEL*	29	30	NC
	D GND	31	32	NC
	NC	33	34	NC
	NC	35	36	AI HOLD COMP, AI HOLD
	SER CLK	37	38	NC
	NC	39	40	NC
	NC	41	42	NC
	RSVD	43	44	NC
	NC	45	46	RSVD
	NC	47	48	NC
	NC	49	50	NC

NC—No Connection

Rear Signal Connector Descriptions

The rear signal connector on the cabled module is the interface between the DAQ device and all modules in the SCXI chassis. CH 0 is used to differentially multiplex all 32 channels, the CJ sensor, and analog signals from the modules to the connected DAQ device.

The communication signals between the DAQ device and the SCXI system are listed in Table 2-4. If the DAQ device is connected to the SCXI-1102/B/C, these digital lines are unavailable for general-purpose digital I/O.

Table 2-4. SCXI-1102/B/C Communication Signals

Pin	SCXI Signal Name	NI-DAQmx Device Signal Name	Traditional NI-DAQ (Legacy) Device Signal Name	Direction	Description
24, 33	DIG GND	D GND	DGND	—	Digital ground—these pins supply the reference for E/M Series DAQ device digital signals and are connected to the module digital ground.
25	SER DAT IN	P0.0	DIO0	Input	Serial data in—this signal taps into the SCXIbus MOSI line to send serial input data to a module or Slot 0.
26	SER DAT OUT	P0.4	DIO4	Output	Serial data out—this signal taps into the SCXIbus MISO line to accept serial output data from a module.
27	DAQ D*/A	P0.1	DIO1	Input	Board data/address line—this signal taps into the SCXIbus D*/A line to indicate to the module whether the incoming serial stream is data or address information.

Table 2-4. SCXI-1102/B/C Communication Signals (Continued)

Pin	SCXI Signal Name	NI-DAQmx Device Signal Name	Traditional NI-DAQ (Legacy) Device Signal Name	Direction	Description
29	SLOT0SEL*	P0.2	DIO2	Input	Slot 0 select—this signal taps into the SCXIbus INTR* line to indicate whether the information on MOSI is being sent to a module or Slot 0.
36	SCANCLK	AI HOLD COMP, AI HOLD	SCANCLK	Input	Scan clock—a rising edge indicates to the scanned SCXI module that the E/M Series DAQ device has taken a sample and causes the module to advance channels.
37	SER CLK	EXTSTROBE*	EXTSTROBE*	Input	Serial clock—this signal taps into the SCXIbus SPICLK line to clock the data on the MOSI and MISO lines.
43, 46	RSVD	RSVD	RSVD	Input	Reserved.
Note: All other pins are not connected.					

Connecting Thermocouples

Refer to the terminal block installation guide, such as the SCXI-1303, for information about connecting thermocouples. NI recommends using an isothermal terminal block, such as the SCXI-1303, for accurate thermocouple measurements.

Connecting RTDs

Refer to the *SCXI-1581 User Manual* for information about connecting RTDs and for additional RTD theory.

Connecting a Current-Loop Receiver

Refer to Appendix E, *Current-Loop Receivers*, for information about connecting current loop receivers.

3

Configuring and Testing

This chapter discusses configuring the SCXI-1102/B/C in MAX for use with either NI-DAQmx or Traditional NI-DAQ (Legacy), creating and testing a virtual channel, global channel, and/or task.

SCXI-1102/B/C Software-Configurable Settings

This section describes how to set the gain/input signal range and how to configure your software for compatible sensor types. It also describes how to perform configuration of these settings for the SCXI-1102/B/C in NI-DAQmx and Traditional NI-DAQ (Legacy). For more information on the relationship between the settings and the measurements and how to configure settings in your application, refer to Chapter 4, *Theory of Operation*.

Common Software-Configurable Settings

This section describes the most frequently used software-configurable settings for the SCXI-1102/B/C. Refer to Chapter 4, *Theory of Operation*, for a complete list of software-configurable settings.

Gain/Input Range

Gain/input range is a software-configurable setting that allows you to choose the appropriate amplification to fully utilize the range of the E/M Series DAQ device. In most applications NI-DAQ chooses and sets the gain for you determined by the input range. This feature is described in Chapter 4, *Theory of Operation*. Otherwise, you should determine the appropriate gain using the input signal voltage range and the full-scale limits of the SCXI-1102/B/C output. You can select a gain of 1 or 100 on a per channel basis.

CJC Source/Value

When using a terminal block that has a CJ sensor for thermocouple measurements, you can set the CJC source as internal, which scans the sensor at the beginning of each measurement and scales the readings accordingly.

Configurable Settings in MAX

Note If you are not using an NI ADE, using an NI ADE prior to version 7.0, or are using an unlicensed copy of an NI ADE, additional dialog boxes from the NI License Manager appear allowing you to create a task or global channel in unlicensed mode. These messages continue to appear until you install version 7.0 or later of an NI ADE.

This section describes where users can access each software-configurable setting for modification in MAX. The location of the settings varies depending on the version of NI-DAQ you use. Refer to either the *NI-DAQmx* section or the *Traditional NI-DAQ (Legacy)* section. You also can refer to the *DAQ Getting Started Guide* and the *SCXI Quick Start Guide* for more information on installing and configuring the hardware. You also can use the DAQ Assistant to graphically configure common measurement tasks, channels, or scales.

NI-DAQmx

Using NI-DAQmx, you can configure software settings such as sensor type and gain/input signal range in the following ways:

- Task or global channel in MAX
- Functions in your application

Note All software-configurable settings are not configurable both ways. This section only discusses settings in MAX. Refer to Chapter 4, *Theory of Operation*, for information on using functions in your application and for information on configuring the settings for your application using Traditional NI-DAQ (Legacy).

You can use the SCXI-1102/B/C module to make the following types of measurements:

- Voltage input
- Thermocouple
- RTD
- Thermistors
- Current input

Creating a Global Channel or Task

To create a new voltage, temperature, or current input NI-DAQmx global task or channel, complete the following steps:

1. Double-click **Measurement & Automation** on the desktop.
2. Right-click **Data Neighborhood** and select **Create New**.
3. Select **NI-DAQmx Task** or **NI-DAQmx Global Channel**, and click **Next**.
4. Select **Analog Input**.
5. Select one of the following:
   - **Voltage**
   - **Temperature**

     and then select one of the following:
     - **Iex Thermistor**
     - **RTD**
     - **Thermocouple**
     - **Vex Thermistor**
   - **Current**
6. If you are creating a task, you can select a range of channels by holding down the <Shift> key while selecting the channels. You can select multiple individual channels by holding down the <Ctrl> key while selecting channels. If you are creating a channel, you can only select one channel. Click **Next**.
7. Name the task or channel and click **Finish**.
8. Select the channel(s) you want to configure. You can select a range of channels by holding down the <Shift> key while selecting the channels. You can select multiple individual channels by holding down the <Ctrl> key while selecting channels.

Note If you want to add channels of various measurement types to the same task, click the **Add Channels** button to select the measurement type for the additional channels.

9. Enter the specific values for your application in the **Settings** tab. Context help information for each setting is provided on the right side of the screen. Configure the input signal range using either **NI-DAQmx Task** or **NI-DAQmx Global Channel**. When you set the minimum and maximum range of **NI-DAQmx Task** or **NI-DAQmx Global Channel**, the driver selects the best gain for the measurement.

You also can set it through your application. Refer to Chapter 3, *Configuring and Testing*, for more information.

10. If you are creating a task and want to set timing or triggering controls, enter the values in the **Task Timing** and **Task Triggering** tabs.

Traditional NI-DAQ (Legacy)

Using Traditional NI-DAQ (Legacy), you can configure software settings, such as gain/input signal range in the following three ways:

- module property pages in MAX
- virtual channels properties in MAX
- functions in your ADE

Note All software-configurable settings are not configurable in all three ways. This section only discusses settings in MAX. Refer to Chapter 4, *Theory of Operation*, for information on using functions in your application.

Most of these settings are available in module properties and/or using virtual channels:

- Gain/input signal range—configure gain using module properties. When you set the minimum and maximum range of the virtual channel, the driver selects the best gain. The default gain setting for Traditional NI-DAQ (Legacy) is 100.

Note Refer to Chapter 4, *Theory of Operation*, for information on configuring the settings for your application using Traditional NI-DAQ (Legacy).

Configuring Module Property Pages in Traditional NI-DAQ (Legacy)

1. Right-click the SCXI-1102/B/C module you want to configure and select **Properties**. Click **General**.
2. If the module you are configuring is connected to an E Series DAQ device, select that device by using **Connected to**. If you want the E Series DAQ device to control the chassis, confirm there is a check in the **This device will control the chassis** checkbox. If the module you are configuring is not connected to an E Series DAQ device, select **None**.

3. Click the **Channel** tab. Select the appropriate gain for each channel. If you want to configure all the channels at the same time, select the **Channel** drop-down list, scroll to the bottom, and select **All Channels**. Refer to the *SCXI-1102/B/C Software-Configurable Settings* section for a detailed description of each setting. Click **Apply**.
4. Click **Accessory**. Select the accessory you connected to the module. When configuration is complete, click **OK**.

The Traditional NI-DAQ (Legacy) chassis and SCXI-1102/B/C should now be configured properly. If you need to change the module configuration, right-click the module and repeat steps 1 through 4. Test the system following the steps in the *Troubleshooting the Self-Test Verification* section of Chapter 1, *About the SCXI-1102/B/C*.

Creating a Virtual Channel

To create a virtual channel, complete the following steps:

1. Right-click **Data Neighborhood** and select **Create New**.
2. Select **Traditional NI-DAQ Virtual Channel** and click **Finish**.
3. Select **Analog Input** from the drop-down menu and click **Next**.
4. Enter the **Channel Name** and **Channel Description**, and click **Next**.
5. Select one of the following measurement types from the drop-down menu:
   - **Voltage**
   - *X* **Thermocouple**
   - *X* **RTD**
   - **Current**
6. Click **Next**.
7. The next windows ask for information that is dependent upon the selection made in step 5. Supply the needed information and click **Next** as needed.
8. Click **Finish**.

Verifying the Signal

This section describes how to take measurements using test panels in order to verify signal, and configuring and installing a system in NI-DAQmx and Traditional NI-DAQ (Legacy).

Verifying the Signal in NI-DAQmx Using a Task or Global Channel

You can verify the signals on the SCXI-1102/B/C using NI-DAQmx by completing the following steps:

1. Click **+** next to **Data Neighborhood**.
2. Click **+** next to **NI-DAQmx Tasks**.
3. Click the task.
4. Select the channel(s) you want to verify. You can select a block of channels by holding down the <Shift> key or multiple channels by holding down the <Ctrl> key. Click **OK**.
5. Enter the appropriate information on the **Settings** tab.
6. Click the **Test** button.
7. Click the **Start** button.
8. After you have completed verifying the channels, click the **Stop** button.

You have now verified the SCXI-1102/B/C configuration and signal connection.

Note For more information on how to further configure the SCXI-1102/B/C, or how to use LabVIEW to configure the module and take measurements, refer to Chapter 4, *Theory of Operation*.

Verifying the Signal in Traditional NI-DAQ (Legacy)

This section discusses how to verify the signal in Traditional NI-DAQ (Legacy) using channel strings and virtual channels.

Verifying the Signal Using Virtual Channel

If you have already created a virtual channel, complete the following steps to verify the signal:

1. Right-click the virtual channel you want to verify and select **Test**.
2. In **Channel Names**, select the channel you want to verify.
3. When you have completed verifying the channel, click **Close**.

Verifying the Signal Using Channel Strings

Refer to AppendixChapter B, *Using SCXI Channel Strings with Traditional NI-DAQ (Legacy) 7.0 or Later*, for information about formatting channel strings.

Complete the following steps to use channel strings in verifying the signal:

1. Click **+** next to **Devices and Interfaces**.
2. Click **+** next to **Traditional NI-DAQ Devices**.
3. Right-click the appropriate E Series DAQ device.
4. Click **Test Panels**.
5. Enter the channel string.
6. Enter the input limits.
7. Select the **Data Mode**.
8. Select the **Y Scale Mode**.

Refer to the *LabVIEW Measurements Manual* for more information and for proper formatting of channel strings for different uses.

4

Theory of Operation

This section includes a brief overview and a detailed discussion of the circuit features of the module.

Refer to Figure 4-1 while reading this section.

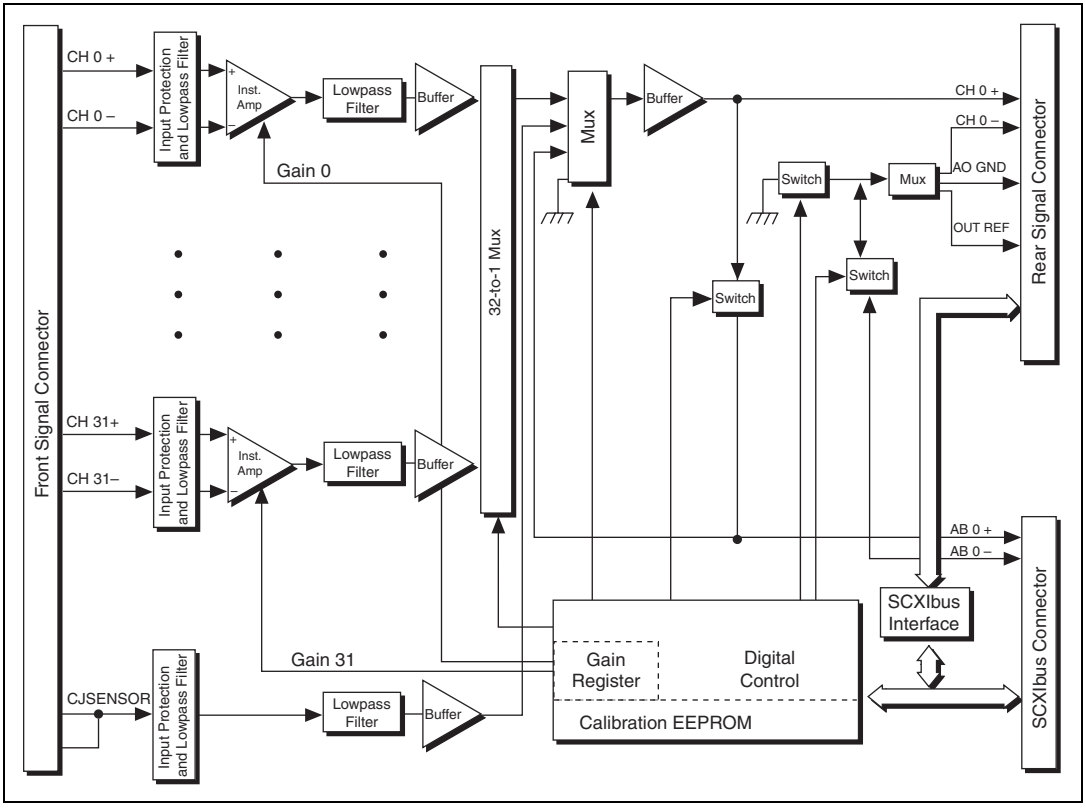


Figure 4-1. SCXI-1102/B/C Module Block Diagram

The major components of the SCXI-1102/B/C modules are as follows:

- Rear signal connector
- SCXIbus connector
- SCXIbus interface

- Digital control circuitry
- Analog circuitry

The SCXI-1102/B/C modules consist of 32 multiplexed input channels, each with a software-programmable gain of 1 or 100. Each input channel has its own lowpass filter. The SCXI-1102/B/C modules also have a digital section for automatic control of channel scanning, temperature sensor selection, and gain selection.

Rear Signal Connector, SCXIbus Connector, and SCXIbus Interface

The SCXIbus controls the SCXI-1102/B/C module. The SCXIbus interface connects the rear signal connector to the SCXIbus, allowing a DAQ device to control the SCXI-1102/B/C module and the rest of the chassis.

Digital Control Circuitry

The digital control circuitry consists of the Address Handler and registers that are necessary for identifying the module, starting calibration information, setting the gain, and selecting the appropriate channel.

Analog Circuitry

The analog circuitry per channel consists of a lowpass filter and an amplifier with a software selectable gain of 1 or 100. The CJ SENSOR channel also has a buffered lowpass filter but has no amplifier. The channels and CJ SENSOR are multiplexed to a single output buffer.

Analog Input Channels

Each of the 32 analog input channels feeds to a separate amplifier with a programmable gain of 1 or 100. Then the signal passes through a fixed lowpass filter.

Note Because of the 2 Hz bandwidth of the SCXI-1102 module input channels, after changing the gains you must wait approximately 3 s for the channels settle in order to get an accurate measurement. NI-DAQ automatically accounts for this time and determines when the module output has settled. For the SCXI-1102B and SCXI-1102C modules, this time is approximately 100 ms and 1 ms, respectively.

The CJ SENSOR input channel is used to read the sensor temperature from the terminal blocks that have one, such as the SCXI-1300 and SCXI-1303. The temperature sensor is for cold-junction compensation thermocouple measurements. The CJ SENSOR channel also passes through a 2 Hz lowpass filter to reject unwanted noise on the SCXI-1102/B/C. Along with the other 32 input channels, the CJ SENSOR is multiplexed to the output buffer, where it can be read by the DAQ device.

Theory of Multiplexed Operation

The SCXI-1102/B/C operates in multiplexed mode. which means that all input channels of the SCXI module are multiplexed into a single analog input channel of the E/M Series DAQ device. Multiplexed mode operation is ideal for high channel count systems. The power of SCXI multiplexed mode scanning is its ability to route many input channels to a single channel of the E/M Series DAQ device.

The multiplexing operation of the analog input signals is performed entirely by multiplexers in the SCXI modules, not inside the E/M Series DAQ device or SCXI chassis. The SCXI-1102/B/C scanned channels are kept by the NI-DAQ driver in a scan list. Immediately prior to a multiplexed scanning operation, the SCXI chassis is programmed with a module scan list that controls which module sends its output to the SCXIbus during a scan through the cabled SCXI module.

The list can contain channels in any physical order, but the SCXI-1102/B/C multiplexer can only sequence the channels in the order 0, 1..31. The SCXI-1102/B/C cannot skip channels or scan channels in random order. The ordering of scanned channels must be sequential. The scan list is limited to a total of 512 channels per E/M Series DAQ device.

When you configure a module for multiplexed mode operation, the routing of multiplexed signals to the E/M Series DAQ device depends on which module in the SCXI system is cabled to the E/M Series DAQ device. There are several possible scenarios for routing signals from the multiplexed modules to the E/M Series DAQ device.

If the scanned SCXI-1102/B/C module is not directly cabled to the E/M Series DAQ device, the module sends its signals through the SCXIbus to the cabled module. The cabled module, whose routing is controlled by the SCXI chassis, routes the SCXIbus signals to the E/M Series DAQ device through the CH 0 pin on its rear signal connector.

If the E/M Series DAQ device scans the cabled module, the module routes its input signals through the CH 0 pin on its rear signal connector to the E/M Series DAQ device CH 0.

Multiplexed mode scanning acquisition rates have limitations that are determined based on the hardware in the system, and the mode of operation. The maximum multiplexing rate of SCXI is 333 kHz. If the E/M Series DAQ device can sample more quickly than 333 kHz, then the maximum multiplexing rate of SCXI is the limiting factor. If the E/M Series DAQ device cannot sample at 333 kS/s, the sample rate of the E/M Series DAQ device is the limiting factor on the maximum acquisition rate of the system.

Since you must scan the SCXI-1102/B/C sequentially, the driver automatically scans channels not included in the scan list if a sequential order is not maintained. When this happens, the maximum sample rate is also factored into the channels that are scanned and discarded for the purpose of completing the scan list.

For measurement accuracy of 0.012% of full scale, the minimum scan interval is 3 μs, which is the smallest interval in which you can switch between analog channels on the module and still measure accurate voltages. The 3 μs scan interval gives you a maximum sampling rate of 333 kHz. For better accuracy, you must increase the scan interval in accordance with the specifications, which will reduce the maximum aggregate sample rate.

5

Using the SCXI-1102/B/C

This chapter makes suggestions for developing your application and provides basic information regarding calibration.

Developing Your Application in NI-DAQmx

Note If you are not using an NI ADE, using an NI ADE prior to version 7.0, or are using an unlicensed copy of an NI ADE, additional dialog boxes from the NI License Manager appear allowing you to create a task or global channel in unlicensed mode. These messages continue to appear until you install version 7.0 or later of an NI ADE.

This section describes how to configure and use NI-DAQmx to control the SCXI-1102/B/C in LabVIEW, LabWindows/CVI, and Measurement Studio. These ADEs provide greater flexibility and access to more settings than MAX, but you can use ADEs in conjunction with MAX to quickly create a customized application.

Typical Program Flowchart

Figure 5-1 shows a typical program voltage measurement flowchart for creating a task to configure channels, take a measurement, analyze the data, present the data, stop the measurement, and clear the task.

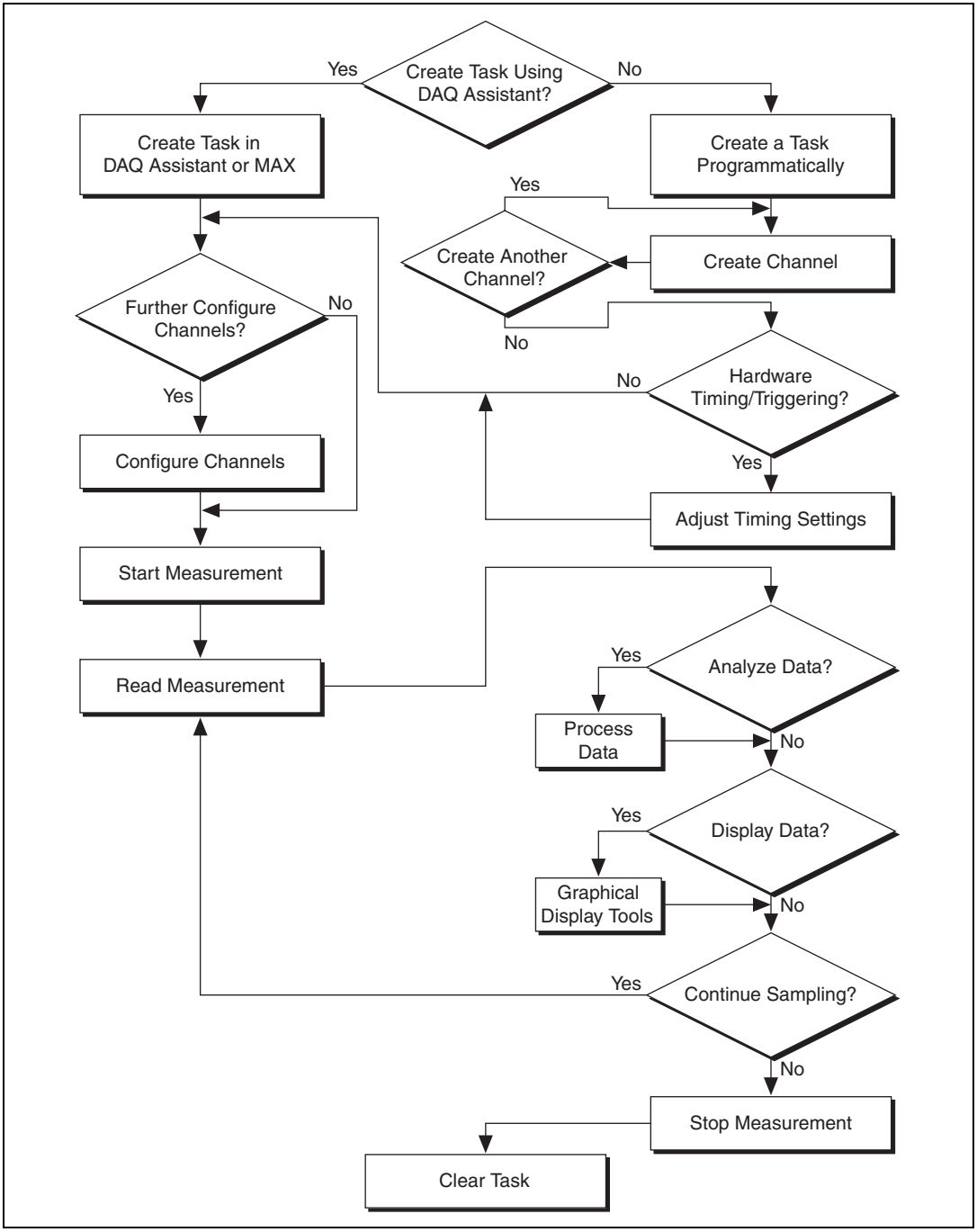


Figure 5-1. Typical Program Flowchart for Voltage Measurement Channels

General Discussion of Typical Flowchart

The following sections briefly discuss some considerations for a few of the steps in Figure 5-1. These sections are meant to give an overview of some of the options and features available when programming with NI-DAQmx.

Creating a Task Using DAQ Assistant or Programmatically

When creating an application, you must first decide whether to create the appropriate task using the DAQ Assistant or programmatically in the ADE.

Developing your application using DAQ Assistant gives you the ability to configure most settings such as measurement type, selection of channels, excitation voltage, signal input limits, task timing, and task triggering. You can access the DAQ Assistant through MAX or your NI ADE. Choosing to use the DAQ Assistant can simplify the development of your application. NI recommends creating tasks using the DAQ Assistant for ease of use, when using a sensor that requires complex scaling, or when many properties differ between channels in the same task.

If you are using an ADE other than an NI ADE, or if you want to explicitly create and configure a task for a certain type of acquisition, you can programmatically create the task from your ADE using functions or VIs. If you create a task using the DAQ Assistant, you can still further configure the individual properties of the task programmatically with functions or property nodes in your ADE. NI recommends creating a task programmatically if you need explicit control of programmatically adjustable properties of the DAQ system.

Programmatically adjusting properties for a task created in the DAQ Assistant overrides the original, or default, settings only for that session. The changes are not saved to the task configuration. The next time you load the task, the task uses the settings originally configured in the DAQ Assistant.

Adjusting Timing and Triggering

There are several timing properties that you can configure through the DAQ Assistant or programmatically using function calls or property nodes. If you create a task in the DAQ Assistant, you can still modify the timing properties of the task programmatically in your application.

When programmatically adjusting timing settings, you can set the task to acquire continuously, acquire a buffer of samples, or acquire one point at a

time. For continuous acquisition, you must use a while loop around the acquisition components even if you configured the task for continuous acquisition using MAX or the DAQ Assistant. For continuous and buffered acquisitions, you can set the acquisition rate and the number of samples to read in the DAQ Assistant or programmatically in your application. By default, the clock settings are automatically set by an internal clock based on the requested sample rate. You also can select advanced features such as clock settings that specify an external clock source, internal routing of the clock source, or select the active edge of the clock signal.

Configuring Channel Properties

All ADEs used to configure the SCXI-1102/B/C access an underlying set of NI-DAQmx properties. Table 5-1 shows some of these properties. You can use Table 5-1 to determine what kind of properties you need to set to configure the module for your application. For a complete list of NI-DAQmx properties, refer to your ADE help file.

Note You cannot adjust some properties while a task is running. For these properties, you must stop the task, make the adjustment, and re-start the application. Tables 5-1, 5-2, 5-3, and 5-4 assume all properties are configured before the task is started.

Table 5-1. NI-DAQmx Voltage Measurement Properties

Property	Short Name	Description
Analog Input»Maximum Value	AI.Max	Specifies the maximum value you expect to measure. The SCXI-1102/B/C gain and E/M Series DAQ device range are computed automatically from this value.
Analog Input»Minimum Value	AI.Min	Specifies the minimum value you expect to measure. The SCXI-1102/B/C gain and E/M Series DAQ device range are computed automatically from this value.
Analog Input»General Properties» Advanced»Range»High	AI.RNG.High	Specifies the upper limit of the E/M Series DAQ device input range in voltage.

Table 5-1. NI-DAQmx Voltage Measurement Properties (Continued)

Property	Short Name	Description
Analog Input»General Properties» Advanced»Range»Low	AI.RNG.Low	Specifies the lower limit of the E/M Series DAQ device input range in voltage.
Analog Input»General Properties» Advanced»Gain and Offset»Gain Value	AI.Gain	Specifies a gain factor to apply to the signal conditioning portion of the channel.

Table 5-2. NI-DAQmx Thermocouple Measurement Properties

Property	Short Name	Description
Analog Input»Temperature» Thermocouple»Type	AI.Thermcpl.Type	Specifies the type of thermocouple connected to the channel.
Analog Input»Temperature» Thermocouple»CJC Source (read only)	AI.Thermcpl.CJCSrc	Indicates the source of cold-junction compensation.
Analog Input»Temperature» Thermocouple»CJC Value	AI.Thermcpl.CJCVal	Specifies the temperature of the cold-junction if the CJC source is constant value.
Analog Input»Temperature» Thermocouple»CJC Channel (read only)	AI.Thermcpl.CJCChan	Indicates the channel that acquires the temperature of the cold junction if CJC is channel.
Analog Input»Temperature» Advanced»Force Read From Channel	AI.ForceReadFromChan	Specifies whether to return the reading from the CJC channel during a read operation.

Table 5-3. NI-DAQmx RTD Measurement Properties

Property	Short Name	Description
Analog Input»Temperature» RTD»Type	AI.RTD.Type	Specifies the type of RTD connected to the channel.
Analog Input»Temperature» RTD»R0	AI.RTD.R0	Specifies the resistance in ohms of the sensor at 0 °C.

Table 5-3. NI-DAQmx RTD Measurement Properties (Continued)

Property	Short Name	Description
Analog Input»Temperature» RTD»Custom»A, B, C	AI.RTD.A AI.RTD.B AI.RTD.C	Specifies the A, B, or C constant of the Callendar-Van Dusen equation when using a custom RTD type.
Analog Input»General Properties» Signal Conditioning»Resistance Configuration	AI.Resistance.Cfg	Specifies the resistance configuration for the channel, such as 2-wire, 3-wire, or 4-wire.

Table 5-4. NI-DAQmx Thermistor Measurement Properties

Property	Short Name	Description
Analog Input»Temperature» Thermistor»R1	AI.Thrmistr.R1	Specifies the resistance in ohms of the sensor at 0 °C.
Analog Input»Temperature» Thermistor»Custom»A, B, C	AI.Thrmistr.A AI.Thrmistr.B AI.Thrmistr.C	Specifies the A, B, or C constant of the Callendar-Van Dusen equation when using a custom thermistor type.

Table 5-5. NI-DAQmx Current Measurement Properties

Property	Short Name	Description
Analog Input»General Properties» Signal Conditioning»Current ShuntResistors»Location	AI.CurrentShunt.Loc	Specifies the shunt resistance location.
Analog Input»General Properties» Signal Conditioning»Current Shunt Resistor»Value	AI.CurrentShunt.Resistance	Specifies the resistance, in ohms, of the external shunt resistance.

Note This is *not* a complete list of NI-DAQmx properties and does not include every property you may need to configure your application. It is a representative sample of important properties to configure for voltage measurements. For a complete list of NI-DAQmx properties and more information about NI-DAQmx properties, refer to your ADE help file.

Acquiring, Analyzing, and Presenting

After configuring the task and channels, you can start the acquisition, read measurements, analyze the data returned, and display it according to the needs of your application. Typical methods of analysis include digital filtering, averaging data, performing harmonic analysis, applying a custom scale, or adjusting measurements mathematically.

NI provides powerful analysis toolsets for each NI ADE to help you perform advanced analysis on the data without requiring you to have a programming background. After you acquire the data and perform any required analysis, it is useful to display the data in a graphical form or log it to a file. NI ADEs provide easy-to-use tools for graphical display, such as charts, graphs, slide controls, and gauge indicators. NI ADEs have tools that allow you to easily save the data to files such as spread sheets for easy viewing, ASCII files for universality, or binary files for smaller file sizes.

Completing the Application

After you have completed the measurement, analysis, and presentation of the data, it is important to stop and clear the task. This releases any memory used by the task and frees up the DAQ hardware for use in another task.

Note In LabVIEW, tasks are automatically cleared.

Developing an Application Using LabVIEW

This section describes in more detail the steps shown in the typical program flowchart in Figure 5-1, such as how to create a task in LabVIEW and configure the channels of the SCXI-1102/B/C. If you need more information or for further instructions, select **Help»VI, Function, & How-To Help** from the LabVIEW menu bar.

Note Except where otherwise stated, the VIs in Table 5-6 are located on the **Functions» All Functions»NI Measurements»DAQmx - Data Acquisition** subpalette and accompanying subpalettes in LabVIEW.

Table 5-6. Programming a Task in LabVIEW

Flowchart Step	VI or Program Step
Create Task in DAQ Assistant	Create a `DAQmx Task Name Control` located on the **Controls»All Controls»I/O»DAQmx Name Controls** subpalette, right-click it, and select `New Task (DAQ Assistant)`.
Create a Task Programmatically (optional)	`DAQmx Create Task.vi` located on the **Functions» All Functions»NI Measurements»DAQmx - Data Acquisition»DAQmx Advanced Task Options** subpalette—This VI is optional if you created and configured the task using the DAQ Assistant. However, if you use it in LabVIEW, any changes you make to the task are not saved to a task in MAX.
Create Virtual Channel(s)	`DAQMX Create Virtual Channel.vi` located on the **Functions»All Functions»NI Measurements»DAQmx - Data Acquisition** subpalette—Use this VI to add virtual channels to the task. Select the type of virtual channel based on the measurement you plan to perform.
Adjust Timing Settings (optional)	`DAQmx Timing.vi` (Sample Clock by default)—This VI is optional if you created and configured the task using the DAQ Assistant. Any timing settings modified with this VI are not saved in the DAQ Assistant. They are only available for the present session.
Configure Channels (optional)	NI-DAQmx Channel Property Node, refer to the *Using a NI-DAQmx Channel Property Node in LabVIEW* section for more information. This step is optional if you created and fully configured the channels using the DAQ Assistant. Any channel modifications made with a channel property node are not saved in the task in the DAQ Assistant. They are only available for the present session.
Start Measurement	`DAQmx Start Task.vi`
Read Measurement	`DAQmx Read.vi`
Analyze Data	Some examples of data analysis include filtering, scaling, harmonic analysis, or level checking. Some data analysis tools are located on the **Functions»Signal Analysis** subpalette and on the **Functions»All Functions»Analyze** subpalette.

Table 5-6. Programming a Task in LabVIEW (Continued)

Flowchart Step	VI or Program Step
Display Data	You can use graphical tools such as charts, gauges, and graphs to display the data. Some display tools are located on the **Controls»All Controls»Numeric»Numeric Indicator** subpalette and **Controls»All Controls»Graph** subpalette.
Continue Sampling	For continuous sampling, use a While Loop. If you are using hardware timing, you also need to set the `DAQmx Timing.vi` sample mode to Continuous Samples. To do this, right-click the terminal of the `DAQmx Timing.vi` labeled **sample mode** and click **Create»Constant**. Click the box that appears and select **Continuous Samples**.
Stop Measurement	`DAQmx Stop Task.vi` (This VI is optional, clearing the task automatically stops the task.)
Clear Task	`DAQmx Clear Task.vi`

Using a NI-DAQmx Channel Property Node in LabVIEW

You can use property nodes in LabVIEW to manually configure the channels. To create a LabVIEW property node, complete the following steps:

1. Launch LabVIEW.
2. Create the property node in a new VI or in an existing VI.
3. Open the block diagram view.
4. From the **Functions** toolbox, select **All Functions» NI Measurements»DAQmx - Data Acquisition**, and select `DAQmx Channel Property Node`.
5. The **ActiveChans** property is displayed by default. This allows you to specify exactly what channel(s) you want to configure. If you want to configure several channels with different properties, separate the lists of properties with another **Active Channels** box and assign the appropriate channel to each list of properties.

Note If you do not use Active Channels, the properties are set on all of the channels in the task.

6. Right-click **ActiveChans**, and select **Add Element**. Left-click the new **ActiveChans** box. Navigate through the menus, and select the property you wish to define.
7. Change the property to read or write to either get the property or write a new value. Right-click the property, go to **Change To**, and select **Write**, **Read**, or **Default Value**.
8. After you have added the property to the property node, right-click the terminal to change the attributes of the property, add a control, constant, or indicator.
9. To add another property to the property node, right-click an existing property and left-click **Add Element**. To change the new property, left-click it and select the property you wish to define.

Note Refer to the *LabVIEW Help* for information about property nodes and specific NI-DAQmx properties.

Specifying Channel Strings in NI-DAQmx

Use the channel input of **DAQmx Create Channel** to specify the SCXI-1102/B/C channels. The input control/constant has a pull-down menu showing all available external channels. The strings take one of the following forms:

- single device identifier/channel number—for example `SC1Mod1/ch0`
- multiple, noncontinuous channels—for example `SC1Mod1/ch0`, `SC1Mod1/ch4`. This mode can affect the SCXI-1102/B/C sample rate. NI recommends scanning the channels in order.
- multiple continuous channels—for example `SC1Mod1/ch0:4` (channels 0 through 4)

When you have a task containing SCXI-1102/B/C channels, you can set the properties of the channels programmatically using the **DAQmx Channel Property Node**.

Follow the general programming flowchart or open an example to build a basic voltage measurement virtual channel. You can use property nodes in LabVIEW to control, configure, and customize the NI-DAQmx task and SCXI-1102/B/C. To create a LabVIEW property node, complete the following steps:

1. Launch LabVIEW.
2. Create the property node in a new Virtual Instrument (VI) or in an existing VI.

3. Open the block diagram view.
4. From the **Functions** tool bar, select **NI Measurements**, **DAQmx - Data Acquisition**, and select the type of property node you wish to configure.
5. Left-click inside the property box and select **ActiveChans**. This allows you to specify what channel(s) you want to configure. If you want to configure several channels with different properties, separate the lists of properties with another **ActiveChans** box, and assign the appropriate channel to each list of properties.
6. Right-click **ActiveChans** and select **Add Element**. Left-click the new **ActiveChans** box. Navigate through the menus and select the property you wish to define.
7. You must change the property to read or write to either get the property or write a new value. Right-click the property, go to **Change To**, and select **Write**, **Read**, or **Default Value**.
8. After you have added the property to the property node, right-click the terminal to change the attributes of the property, add a control, constant, or indicator.
9. To add another property to the property node, right-click an existing property and left-click **Add Element**. To change the new property, left-click it and select the property you wish to define.

Note Refer to the *LabVIEW Help* for information about property nodes and specific NI-DAQmx properties.

Text Based ADEs

You can use text based ADEs such as LabWindows/CVI, Measurement Studio, Visual Basic 6, .NET, and C# to create code for using the SCXI-1102/B/C.

LabWindows/CVI

LabWindows/CVI works with the **DAQ Assistant** in MAX to generate code for an voltage measurement task. You can then use the appropriate function call to modify the task. To create a configurable channel or task in LabWindows/CVI, complete the following steps:

1. Launch LabWindows/CVI.
2. Open a new or existing project.
3. From the menu bar, select **Tools»Create/Edit DAQmx Tasks**.

4. Choose **Create New Task In MAX** or **Create New Task In Project** to load the DAQ Assistant.
5. The DAQ Assistant creates the code for the task based on the parameters you define in MAX and the device defaults. To change a property of the channel programmatically, use the `DAQmxSetChanAttribute` function.

Note Refer to the *NI LabWindows/CVI Help* for more information on creating NI-DAQmx tasks in LabWindows/CVI and NI-DAQmx property information.

Measurement Studio (Visual Basic 6, .NET, and C#)

When creating an voltage measurement task in Visual Basic 6, .NET and C#, follow the general programming flow in Figure 5-1. You can then use the appropriate function calls to modify the task. This example creates a new task and configures an NI-DAQmx voltage measurement channel on the SCXI-1102/B/C. You can use the same functions for Visual Basic 6, .NET and C#.

The following text is a function prototype example:

```
void AIChannelCollection.CreateVoltageChannel(
    System.String physicalChannelName,
    System.String nameToAssignChannel,
    System.Double minVal,
    System.Double maxVal);
```

To actually create and configure the channel, you would enter something resembling the following example code:

```
Task myTask = new
NationalInstruments.DAQmx.Task("myTaskName");
MyTask.DAQmxCreateAIVoltageChan (
    "SC1Mod1/ai0", // System.String physicalChannelName
    "Voltage0", // System.String nameToAssignChannel
    -10.0, // System.Double minVal
    10.0); // System.Double maxVal
// setting attributes after the channel is created
AIChannel myChannel = myTask.AIChannels["Voltage0"];
myChannel.Gain = 100.0;
```

Modify the example code above or the code from one of the shipping examples as needed to suit your application. Refer to the *Other Application Documentation and Material* section for the location of program examples.

Note You can create and configure the voltage measurement task in MAX and load it into your application with the function call `NationalInstruments.DAQmx.DaqSystem.Local.LoadTask`.

Refer to the *NI Measurement Studio Help* for more information on creating NI-DAQmx tasks in LabWindows/CVI and NI-DAQmx property information.

Programmable NI-DAQmx Properties

All of the different ADEs that configure the SCXI-1102/B/C access an underlying set of NI-DAQmx properties. Tables 5-1, 5-2, and 5-3 provide a list of some of the properties that configure the SCXI-1102/B/C. You can use this list to determine what kind of properties you need to set to configure the device for your application. For a complete list of NI-DAQmx properties, refer to your ADE help file.

Note Tables 5-1, 5-2, and 5-3 are *not* complete lists of NI-DAQmx properties and do not include every property you may need to configure voltage measurements. It is a representative sample of important properties to configure voltage measurements. For a complete list of NI-DAQmx properties and more information on NI-DAQmx properties, refer to your ADE help file.

Developing Your Application in Traditional NI-DAQ (Legacy)

Note If you are not using an NI ADE, using an NI ADE prior to version 7.0, or are using an unlicensed copy of an NI ADE, additional dialog boxes from the NI License Manager appear allowing you to create a task or global channel in unlicensed mode. These messages continue to appear until you install version 7.0 or later of an NI ADE.

This section describes how to configure and use Traditional NI-DAQ (Legacy) to control the SCXI-1102/B/C in LabVIEW, LabWindows/CVI, Measurement Studio, and other text-based ADEs. These NI ADEs provide greater flexibility and access to more settings than MAX, but you can use ADEs in conjunction with MAX to quickly create a customized application.

After you have determined how you want to address the channels and whether you want to configure the SCXI-1102/B/C in MAX or LabVIEW, you can design your application using a typical program flow such as the one shown in Figure 5-2.

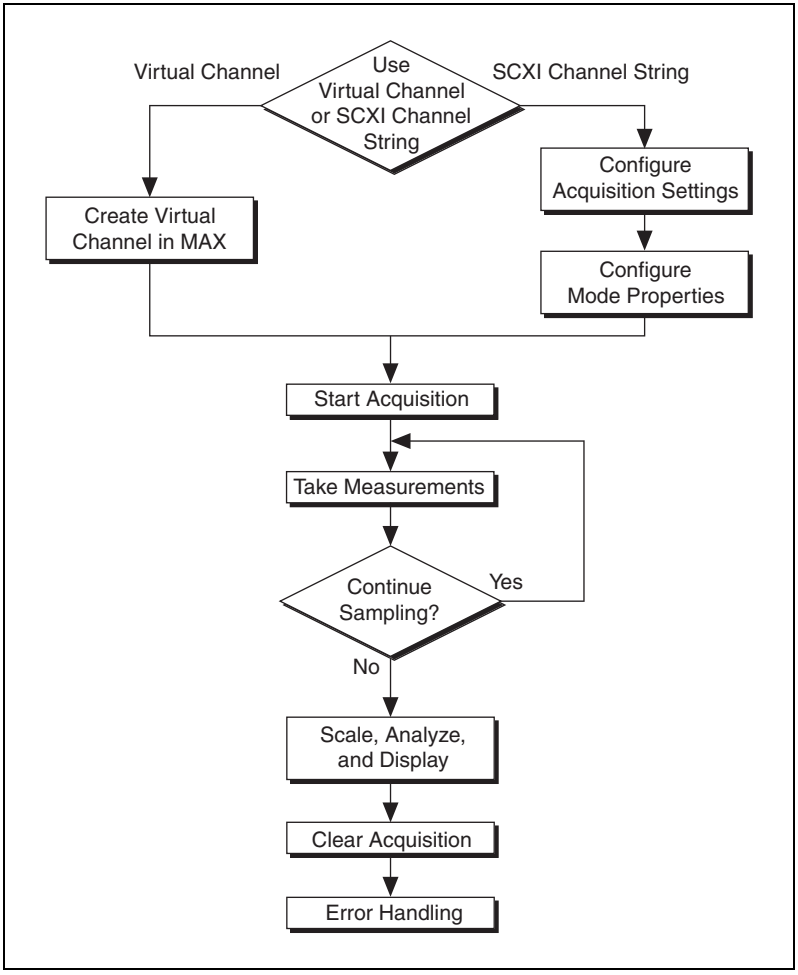


Figure 5-2. Typical SCXI-1102/B/C Program Flow with Traditional NI-DAQ (Legacy)

Other Application Documentation and Material

This section provides information about multiplexed scanning and the Traditional NI-DAQ (Legacy) examples for Measurement Studio and LabWindows/CVI. Refer to the ADE manual and the DAQ analog input examples that come with your application software for more detailed information on programming the SCXI modules for scanning in multiplexed mode.

Using Software for Multiplexed Scanning

Performing scanning operations in software depends on the ADE you are using. While using LabVIEW or Visual Basic 6, all scanning operations are prepared in software by using an SCXI *channel string* as the input to the channel parameter in the analog input VI or function. These ADEs also support virtual channels using Data Neighborhood (DAQ Channel Wizard) in MAX. In LabWindows/CVI, C, or C++ development environments, you need to make several NI-DAQ function calls to set up each module involved in the scan, the chassis, and the E/M Series DAQ device controlling the scan.

A discussion describing how to implement multiplexed scanning in the different ADEs follows. Refer to the ADE manual and the DAQ analog input examples that come with your application software for more detailed information on programming the SCXI modules for scanning in multiplexed mode.

LabVIEW and the SCXI Channel String

For LabVIEW and Visual Basic 6, the channel string determines the sequence in which SCXI channels are scanned. Refer to Appendix B, *Using SCXI Channel Strings with Traditional NI-DAQ (Legacy) 7.0 or Later*, for more information about using SCXI channels strings in Traditional NI-DAQ (Legacy).

LabVIEW and the Virtual Channel String

For LabVIEW and Visual Basic 6, the channel string can also contain virtual channels. For the SCXI-1102/B/C, these virtual channels are analog input channels you create that have custom names, that perform all error correction and scaling without additional code. Virtual channels are particularly useful when sensors requiring different scaling factors are used on the same SCXI-1102/B/C channel. Using virtual channels, you can use sensors needing special scaling in a generic analog input application without performing hard-coded scaling. If you change the scaling or want to connect a different sensor to the SCXI-1102/B/C, no changes are needed in the application. All that is required is creating a different virtual channel and using its name in the channel string.

Note You cannot mix virtual channels with the SCXI channel strings shown in the previous section.

To create a virtual channel for the SCXI-1102/B/C, insert a new analog input channel in the **Data Neighborhood** path in MAX, name it, and then follow the software prompts to create virtual position channels, voltage channels, or customized analog input channels. For more information on virtual channels, consult the MAX online help file.

To use virtual channels, enter the name of a virtual channel into the analog input channel string. If using multiple virtual channels, separate them using a comma, or enter them in a different index in the channel string array. All scaling is done automatically by the application.

Note Since you cannot randomly scan analog input channels, you must enter virtual channels in sequential order.

Performing a Multiplexed Scan

To perform a multiplexed scan in your application, complete the following steps:

1. Open an analog input example in your ADE.
2. Enter the appropriate SCXI channel string or virtual channel string into the **channels** parameter.
3. Either enter the **input limits** for signals connected to the module to adjust the gain settings in the system or use the default gain settings from the configuration utility, and then run the application. When using virtual channels, the default input limits configured in the virtual channel configurator are used.

You have completed a multiplexed scan using the SCXI-1102/B/C.

This is not a comprehensive discussion of SCXI scanning using LabVIEW, but this should give you enough information to help you get started with the examples shipped with these software packages.

C and Low-Level DAQ Functions

When using a C-based environment, you need to take several steps to configure the SCXI-1102/B/C for multiplexed scanning. The following procedure outlines the steps for programming with the low-level NI-DAQ function calls:

1. Prepare the SCXI-1102/B/C settings either by loading the original SCXI configuration settings using `SCXI_Load_Config`, or by specifying all configuration settings using the NI-DAQ function calls in Table 5-7.

Table 5-7. NI-DAQ Functions Used to Configure SCXI-1102/B/C

Channel Setting	NI-DAQ Function to Use
Gain	`SCXI_Set_Gain`

2. Specify the module scan list, the start channel of each module, and the number of channels to scan on each module with the function `SCXI_SCAN_Setup`. This function accepts an array of start channels and an array of the number of channels to scan in each module. Therefore, it is not possible to repeat channels or use nonsequential channels using this function.
3. Use `SCXI_MuxCtr_Setup` to program the E/M Series DAQ device with the correct number of channels multiplexed per scan. This number must match the total number of channels programmed in step 2.

You are now ready to acquire the channel data with the E/M Series DAQ device. If you are using a multifunction E/M Series DAQ device, you can use `SCAN_Op` to perform the scanning operation. After scanning, convert the binary data to voltage data using `SCXI_Scale`. Refer to the *NI-DAQ User Manual* for additional information on scanning with E/M Series DAQ devices.

Traditional NI-DAQ (Legacy) CVI Examples

Many example programs ship with NI-DAQ. For more example information on how to create tasks and channels, refer to the example programs. By default, the example programs are installed in `C:\Program Files\NationalInstruments\CVI 7.0\Samples`. More examples are installed by default in `C:\Program Files\National Instruments\NI-DAQ\Examples`.

Traditional NI-DAQ (Legacy) Measurement Studio Examples

Many example programs ship with NI-DAQ. For more example information on how to create tasks and channels, refer to the example programs. By default, the example programs are installed in `C:\Program Files\NationalInstruments\Measurement Studio 7.0`. More examples are installed by default in `C:\Program Files\National Instruments\NI-DAQ\Examples`.

Calibration

The SCXI-1102/B/C is shipped with a calibration certificate and is calibrated at the factory to the specifications described in Appendix A, *Specifications*. Calibration constants are stored inside the calibration EEPROM and provide software correction values your application development software uses to correct the measurements for both offset and gain errors in the module.

You can download all available external calibration documents by going to `ni.com/calibration` and clicking **Manual Calibration Procedures**. NI recommends you perform an external calibration once a year.

A

Specifications

This appendix lists the specifications for the SCXI-1102/B/C modules. These specifications are typical at 25 °C unless otherwise noted.

Analog Input

Input Characteristics

Number of channels ..... 32 differential

Input signal ranges ..... ±100 mV (gain = 100) or
±10 V (gain = 1)

Input damage level

- Powered on ..... ±42 VDC
- Powered off ..... ±27 VDC
- Inputs protected..... CH<0..31>, CJ SENSOR

Transfer Characteristics

Nonlinearity ..... 0.005% FSR

Offset error

- Gain = 1
  - After calibration..... 300 µV max
  - Before calibration ..... 600 µV
- Gain = 100
  - After calibration..... 15 µV max
  - Before calibration ..... 100 µV

Gain error (relative to calibration reference)

- Gain = 1
  - After calibration..... 0.015% of reading max
  - Before calibration ..... 0.04% of reading

Gain = 100

After calibration .....0.020% of reading max

Before calibration.....0.1% of reading

Amplifier Characteristics

Input impedance

Normal powered on .....>1 GΩ

Powered off .....10 kΩ

Overload .....10 kΩ

Input bias current .....±0.5 nA

Input offset current .....±1.0 nA

CMRR

Characteristics	1102	1102B	1102C
50 to 60 Hz, either gain	110 dB	90 dB	90 dB
DC, gain 1	75 dB min	75 dB min	75 dB min
DC, gain 100	100 dB min	100 dB min	100 dB min

Output range .....±10 V

Output impedance.....91 Ω

Dynamic Characteristics

Bandwidth.....2 Hz (1102)
200 Hz (1102B)
10 kHz (1102C)

Minimum scan interval (per channel, any gain)

±0.012% accuracy .....3 μs

±0.0061% accuracy .....10 μs

System noise (RTI)

Characteristics	1102	1102B	1102C
Gain = 1	50 μV_{rms}	50 μV_{rms}	70 μV_{rms}
Gain = 100	5 μV_{rms}	5 μV_{rms}	10 μV_{rms}

Filters

Cutoff frequency (–3 dB) ..... 2 Hz (1102)
200 Hz (1102B)
10 KHz (1102C)

NMR (60 Hz) ..... 40 dB (1102)

Step response (either gain)

Characteristics	1102	1102B	1102C
To 0.1%	1 s	10 ms	200 µs
To 0.01%	10 s	100 ms	1 µs

Stability

Recommended warm-up time ..... 20 min

Offset temperature coefficient

Gain = 1 ..... 20 µV/°C

Gain = 100 ..... 1 µV/°C

Gain temperature coefficient..... 10 ppm/°C

Power Requirements

5 V supply ..... 15 mA max

±15 V supply (regulated
from ±24 V supply)..... 150 mA max

Physical

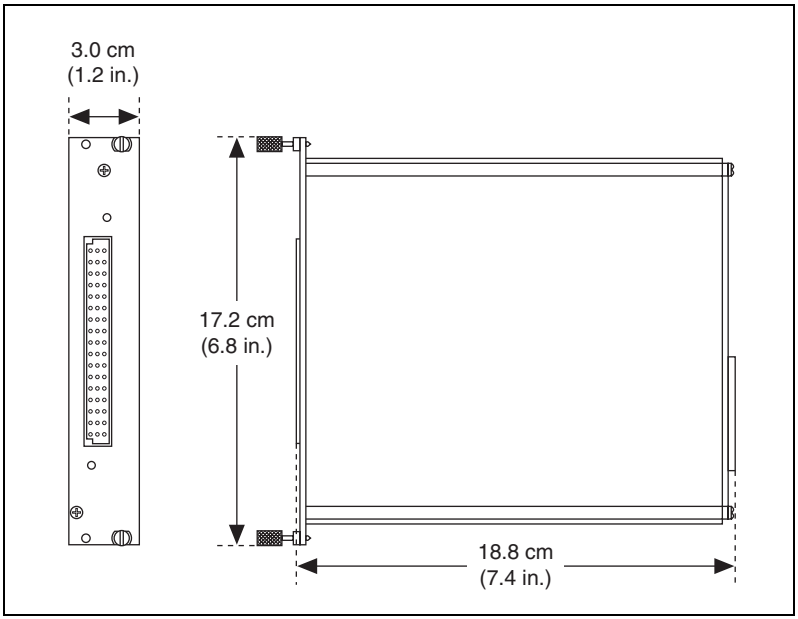


Figure A-1. SCXI-1102/B/C Dimensions

Weight .....611 gm (24.6 oz)

Maximum Working Voltage

Maximum working voltage refers to the signal voltage plus the common-mode voltage.

Signal + common mode .....Each input should remain within ±10 V of CH GND

Environmental

Operating temperature .....0 to 50 °C

Storage temperature .....–20 to 70 °C

Humidity .....10 to 90% RH, noncondensing

Maximum altitude.....2,000 m

Pollution Degree (indoor use only) 2

Safety

This product is designed to meet the requirements of the following standards of safety for electrical equipment for measurement, control, and laboratory use:

- IEC 61010-1, EN-61010-1
- UL 61010-1, CAN/CSA-C22.2 No. 61010-1

Note For UL and other safety certifications, refer to the product label or visit `ni.com/certification`, search by model number or product line, and click the appropriate link in the Certification column.

Electromagnetic Compatibility

This product is designed to meet the requirements of the following standards of EMC for electrical equipment for measurement, control, and laboratory use:

- EN 61326 EMC requirements; Minimum Immunity
- EN 55011 Emissions; Group 1, Class A
- CE, C-Tick, ICES, and FCC Part 15 Emissions; Class A

Note For EMC compliance, operate this device to product documentation.

CE Compliance

This product meets the essential requirements of applicable European Directives, as amended for CE marking, as follows:

- 73/23/EEC; Low-Voltage Directive (safety)
- 89/336/EEC; Electromagnetic Compatibility Directive (EMC)

Note Refer to the Declaration of Conformity (DoC) for this product for any additional regulatory compliance information. To obtain the DoC for this product, visit `ni.com/certification`, search by model number or product line, and click the appropriate link in the Certification column.

Waste Electrical and Electronic Equipment (WEEE)

EU Customers At the end of their life cycle, all products *must* be sent to a WEEE recycling center. For more information about WEEE recycling centers and National Instruments WEEE initiatives, visit `ni.com/environment/weee.htm`.

B

Using SCXI Channel Strings with Traditional NI-DAQ (Legacy) 7.0 or Later

Note This appendix is not applicable if you use the virtual channels to configure and measure the SCXI channels. Virtual channels are configured using MAX. If you use virtual channels, you address the SCXI channels by specifying the channel name(s) in the channel string input.

When using LabVIEW and Visual Basic, the SCXI channel string determines which SCXI channels are scanned and the scanning sequence. The SCXI channel string allows you to take measurements from several channels on one module with only one channel string entry. An array of these channel string entries configures multiple modules for scanning. When the application program runs, the channel string is used for programming the channel information into the SCXI system.

The format of the channel string is as follows:

`obx ! scy ! mdz ! channels`

where

`obx` is the onboard E Series DAQ device channel, with `x` representing a particular channel where the multiplexed channels are sent. This value is 0 for E Series DAQ device channel 0 in a single-chassis system. In a multichassis or remote chassis system, the E Series DAQ device channel `x` corresponds to chassis number $n - 1$, where E Series DAQ device channel `x` is used for scanning the *n*th chassis in the system.

`scy` is the SCXI chassis ID, where `y` is the number you chose when configuring the chassis.

`mdz` is the slot position where the module is located, with `z` being the particular slot number. The slots in a chassis are numbered from left to right starting with 1.

channels is the list of channels that are scanned for module *z*. It can have several formats:

- obx ! scy ! mdz ! *nx*, where *nx* is a single input channel.
- obx ! scy ! mdz ! (*n0, n2*), where *n0, n2* are individual input channel that are not necessarily sequential.
- obx ! scy ! mdz ! *n0*:*n3*, where *n0* and *n3* represent an ascending sequential list of input channels, inclusive.
- obx ! scy ! mdz ! (*n0, n2, n3*:*n4, n1, n5, n2*), where *n0*, *n2*, and *n5* represent single channels, not necessarily sequential, and *n3* and *n4* represent the endpoints of an ascending sequential list of channels, inclusive. In this case, channels *n1* and *n2* are explicitly repeated in the channel list.

Note Using parenthesis surrounding multiple channels in a channel string is important for correct scanning operation of the SCXI channels.

In a single-chassis system, the obx ! specifier is optional and causes the gains on the module and E Series DAQ device to be automatically set to fit the input limits parameter. When this specifier is omitted, the default gain on the E Series DAQ device, usually the lowest gain, is used, but the SCXI-1102/B/C gain is adjusted to fit the input limits. NI recommends using the obx ! specifier.

Repeating channels or having channels out of sequence in a scan list is not supported by the SCXI-1102/B/C and results in an error.

For more information about using SCXI channel string, refer to the *LabVIEW Measurements Manual* and SCXI-1102/B/C shipping examples.

C

Removing the SCXI-1102/B/C

This appendix explains how to remove the SCXI-1102/B/C from MAX and an SCXI chassis.

Note Figure C-1 shows an SCXI chassis, but the same steps are applicable to a PXI/SCXI combination chassis.

Removing the SCXI-1102/B/C from MAX

To remove a module from MAX, complete the following steps after launching MAX:

1. Expand **Devices and Interfaces** to display the list of installed devices and interfaces.
2. Expand **NI-DAQmx Devices** and/or **Traditional NI-DAQ Devices** to display the chassis.
3. Expand the appropriate chassis to display the installed modules.
4. Right-click the module or chassis you want to delete and click **Delete**.
5. You are presented with a confirmation window. Click **Yes** to continue deleting the module or chassis or **No** to cancel this action.

Note Deleting the SCXI chassis deletes all modules in the chassis. All configuration information for these modules is also deleted.

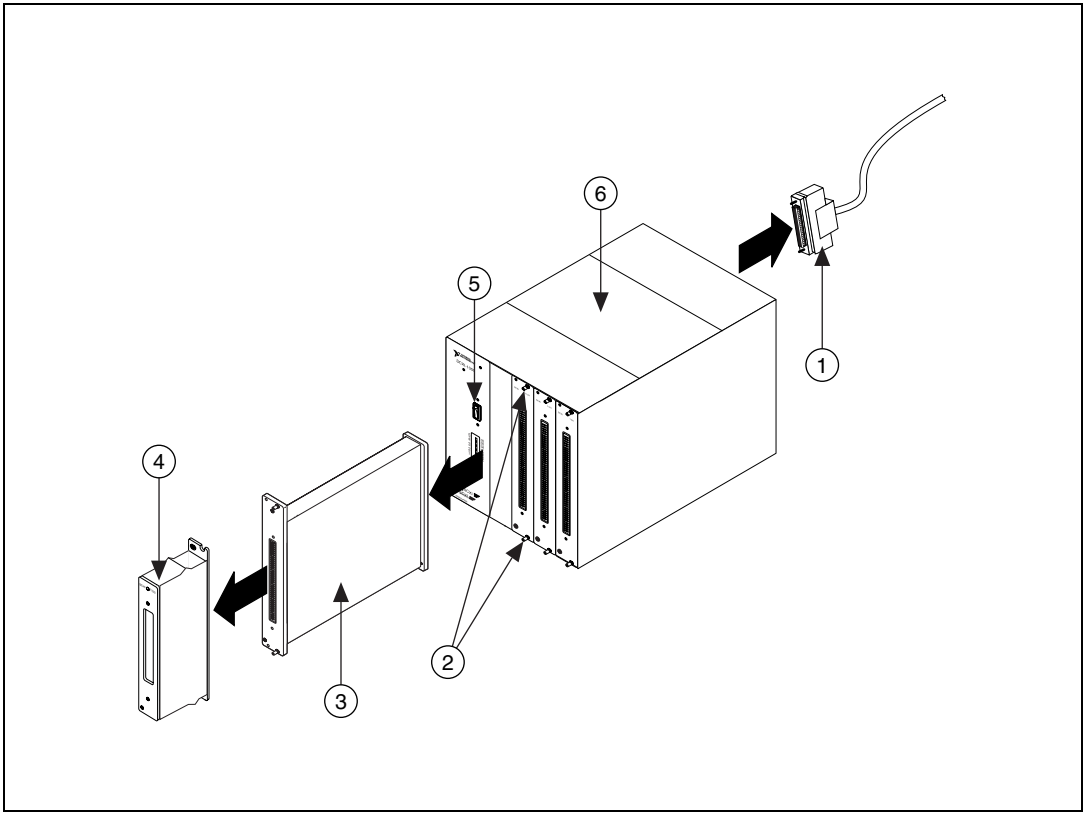
The SCXI chassis and/or SCXI module(s) should now be removed from the list of installed devices in MAX.

Removing the SCXI-1102/B/C from a Chassis

Consult the documentation for the chassis and accessories for additional instructions and precautions. To remove the SCXI-1102/B/C module from a chassis, complete the following steps while referring to Figure C-1:

1. Power off the chassis. Do *not* remove the SCXI-1102/B/C module from a chassis that is powered on.
2. If the SCXI-1102/B/C is the module cabled to the E /M Series DAQ device, disconnect the cable.

3. Remove any terminal block that connects to the SCXI-1102/B/C.
4. Rotate the thumbscrews that secure the SCXI-1102/B/C to the chassis counterclockwise until they are loose, but do not completely remove the thumbscrews.
5. Remove the SCXI-1102/B/C by pulling steadily on both thumbscrews until the module slides completely out.



1 Cable	4 Terminal Block
2 SCXI Module Thumbscrews	5 SCXI Chassis Power Switch
3 SCXI-1102/B/C	6 SCXI Chassis

Figure C-1. Removing the SCXI-1102/B/C

D

Common Questions

This appendix lists common questions related to the use of the SCXI-1102/B/C.

Which version of NI-DAQ works with the SCXI-1102/B/C, and how do I get the most current version of NI-DAQ?

You must have NI-DAQ 7.0 or later. Visit the NI Web site at `ni.com` and select **Download Software»Drivers and Updates»Search Drivers and Updates**. Enter the keyword `NI-DAQ` to find the latest version of NI-DAQ for your operating system.

I have gone over the *Verifying and Self-Testing the Installation* section of Chapter 1, *About the SCXI-1102/B/C*, yet I still cannot correctly test and verify that my SCXI-1102/B/C is working. What should I do now?

Unfortunately, there is always the chance that one or more components in the system are not operating correctly. You may have to call or email a technical support representative. The technical support representative often suggests additional troubleshooting measures. If requesting technical support by phone, have the system nearby so you can try these measures immediately. NI contact information is listed in the *Technical Support Information* document.

In NI-DAQmx, can I use channels of different measurement types in the same task?

Yes.

Does MAX allow me to configure two SCXI-1102/B/C modules that are in the same chassis in the multiplexed mode with two different E/M Series DAQ devices?

No.

Can I use the unused analog input channels of the E/M Series DAQ device if I am directly cabled to the SCXI-1102/B/C, for example with the SCXI-1180 feedthrough?

Yes. E/M Series DAQ device channels 1 through 7 are available when directly connected to the SCXI-1102/B/C.

Which digital lines are unavailable on the E/M Series DAQ device if I am cabled to an SCXI-1102/B/C module?

Table D-1 shows the digital lines that are used by the SCXI-1102/B/C for communication and scanning. These lines are unavailable for general-purpose digital I/O if the SCXI-1102/B/C is connected to the E/M Series DAQ device.

Table D-1. Digital Signals on the SCXI-1102/B/C

E/M Series DAQ Device Signal Name	NI-DAQmx SCXI Signal Name	Traditional NI-DAQ (Legacy) SCXI Signal Name	50-Pin Connector	68-Pin Connector	Direction[1]
DIO0	P0.0	SERDATIN	25	52	Output
DIO4	P0.4	SERDATOUT	26	19	Input
DIO1	P0.1	DAQD*/A	27	17	Output
DIO2	P0.2	SLOT0SEL*	29	49	Output
SCANCLK	AI Hold Comp, AI Hold	SCANCLK	36	46	Output
PFI7/ STARTSCAN	PFI 7/ AI SAMP CLK, AI SAMP	HOLDTRIG	46	38	Input
EXTSROBE*	EXTSROBE*	SERCLK	37	45	Input

[1] With respect to the E/M Series DAQ device.

In LabVIEW, can I use different input limits for the same SCXI-1102/B/C channel if I repeat the channel in the SCXI channel string array?

No. You cannot dynamically change the SCXI-1102/B/C gain settings during scanning. Therefore, group channels with similar input ranges together in the channel string array. Make sure that repeated channels in different indices of the channel string array have the same input limits in the corresponding input limits array.

In LabVIEW, can I use a VI to change my SCXI-1102/B/C configuration settings?

Yes. In Traditional NI-DAQ (Legacy) you can use the AI Parameter VI to change all the SCXI-1102/B/C configuration settings. You also can change the configuration settings in NI-DAQmx using **NI-DAQmx Tasks**.

Are there any cabling restrictions when using an SCXI-1102/B/C module with a plug-in E/M Series DAQ device?

Yes. If a chassis contains an SCXI-1520, SCXI-1530/1531, or SCXI-1140 module, at least one of these modules must be the cabled module. A cabled module is the module connected directly to the E/M Series DAQ device. This ensures that a timing signal is available for use by all simultaneous-sampling SCXI modules in the chassis.

Is a register-level programming manual available for the SCXI-1102/B/C?

NI does not support register-level programming for the SCXI-1102/B/C.

What is the power-on state of the SCXI-1102/B/C multiplexer, analog bus switches, and configuration settings?

The multiplexer, analog bus switches, and configuration settings are not in a known state immediately after power on. All hardware settings are programmed automatically when beginning an acquisition in LabVIEW or a test panel in MAX.

Which accessories can I use to connect signals to the front of the SCXI-1102/B/C module?

Refer to Chapter 1, *About the SCXI-1102/B/C*, for more information.

E

Current-Loop Receivers

Notes NI recommends that you use the NI-1308 with socketed shunt resistors.

You must remove soldered resistors for calibration.

The SCXI-1102/B/C modules have pads for transforming individual channels to current-to-voltage converters. NI offers an SCXI process-current pack of four 249 Ω, 0.1%, 5 ppm, 1/4 W resistors. The reference designators for the current loop resistors have the format: for input channel *x*, the resistor is RCL*x*. For example, the resistor for channel 28 is RCL28.

Caution Before installing the resistors in the module, make sure that there are no signals connected to the module front connector.

Before installing the module in the SCXI chassis, you must install the resistors by completing the following steps:

1. Ground yourself with a grounding strap or with a ground connected to the SCXI chassis.

Note Properly grounding yourself prevents damage to the SCXI module from electrostatic discharge.

2. Remove the grounding screw of the top cover.
3. Snap out the top cover of the shield by placing a screwdriver in the groove at the bottom of the module and pushing down.
4. Remove the rear panel by unscrewing the two remaining screws.
5. Slide the module out of its enclosure.

6. Bend and trim the resistor lead as shown in Figure E-1. Be sure that the resistor does not extend more than 16.5 mm (0.65 in.) above the surface of the circuit board.

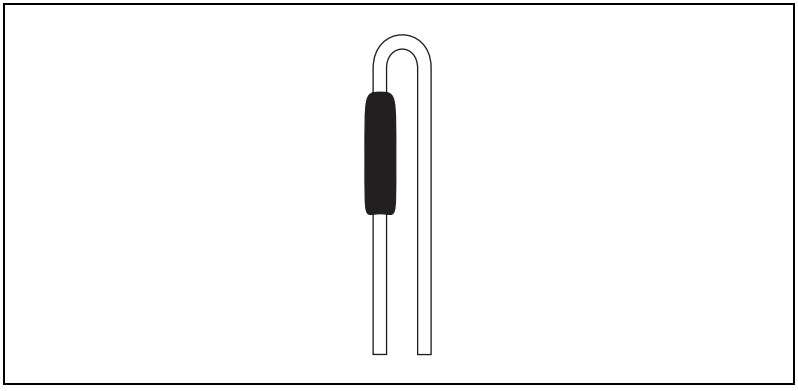


Figure E-1. Bent and Trimmed Resistor

7. Insert the resistor into the appropriate pad, labeled RCL*x*.
8. Solder the leads to the pad on the bottom side of the module.
9. Slide the module back into its enclosure.
10. Reinstall the rear panel.
11. Reinstall the top cover and grounding screw.

Glossary

Symbol	Prefix	Value
p	pico	10^{-12}
n	nano	10^{-9}
μ	micro	10^{-6}
m	milli	10^{-3}
k	kilo	10^{3}
M	mega	10^{6}
G	giga	10^{9}

Numbers/Symbols

%	Percent.
±	Plus or minus.
°	Degrees.
Ω	Ohms.
+5 V	+5 VDC source signal.

A

A	Amperes.
A/D	Analog-to-digital.
absolute accuracy	The maximum difference between the measured value from a data acquisition device and the true voltage applied to the input, typically specified as ± voltage.
AC	Alternating current.
ADE	Application development environment.

AI GND	Analog input ground signal.
AI +	Positive analog output channel number signal.
AI # +	Positive input channel number signal.
AI # –	Negative input channel number signal.
AO #	Data acquisition device analog output channel number.
AO # +	Positive output channel number signal.
AO # –	Negative output channel number signal.
AI HOLD COMP, AI HOLD	Scan clock signal used to increment to the next channel after each DAQ device analog-to-digital conversion.
amplification	A type of signal conditioning that improves accuracy in the resulting digitized signal by increasing signal amplitude relative to noise.
AO GND	(DAQ and SCXI) analog output ground signal.
AO REF	Analog output reference.

B

bandwidth	The range of frequencies present in a signal, or the range of frequencies to which a measuring device can respond.
bias current	The small input current flowing into or out of the input terminals of an amplifier.
bit	One binary digit, either 0 or 1.
bus	The group of conductors that interconnect individual circuitry in a computer. Typically, a bus is the expansion interface to which I/O or other devices are connected. Examples of a PC bus is a PCI bus.

C

C	Celsius.
CE	European emissions control standard.
CH GND	Chassis ground signal.
CH	Analog input channel signal.
channel	Pin or wire lead to which you apply or from which you read the analog or digital signal. Analog signals can be single-ended or differential. For digital signals, you group channels to form ports. Ports usually consist of either four or eight digital channels.
chassis	The enclosure that houses, powers, and controls SCXI modules.
CJ SENSOR	Cold-junction temperature sensor.
CLK	Clock input signal.
clock	Hardware component that controls timing for reading from or writing to groups.
CMRR	Common-mode rejection ratio—a measure of the ability of a differential amplifier to reject interference from a common-mode signal, usually expressed in decibels (dB).
common-mode voltage	Voltage that appears on both inputs of a differential amplifier.
cutoff frequency	The frequency that defines the upper end of the passband of a lowpass filter.

D

D/A	Digital-to-analog.
DAQ device	A data acquisition device.
DAQD*/A	The data acquisition device data/address line signal used to indicate whether the SER DAT IN pulse train transmitted to the SCXI chassis contains data or address information.
dB	Decibel—the unit for expressing a logarithmic measure of the ratio of two signal levels: $dB = 20\log_{10} V1/V2$, for signals in volts.

DC	Direct current.
device	A plug-in data acquisition product, card, or pad that can contain multiple channels and conversion devices. Plug-in products, PCMCIA cards, and devices such as DAQPads, which connects to the computer parallel port, are all examples of DAQ devices. SCXI modules are distinct from devices.
D GND	Digital ground signal.
differential input	An analog input consisting of two terminals, both of which are isolated from computer ground, whose difference is measured.
DIO	Digital input/output.
DMA	Direct memory access—a method by which data is transferred to/from computer memory from/to a device or memory on the bus while the processor does something else. DMA is the fastest method of transferring data to/from computer memory.
DMM	Digital multimeter.
D OUT	Digital output signal.
drivers/driver software	Software that controls a specific hardware device, such as an E/M Series DAQ device.

E

EEPROM	Electrically erasable programmable read-only memory—ROM that can be erased with an electrical signal and reprogrammed.
EMC	Electromagnetic compliance.
EMI	Electromagnetic interference.

EXTSTROBE*	EXTSTROBE* is an output-only signal that generates either a single pulse or a sequence of eight pulses in the hardware-strobe mode. An external device can use this signal to latch signals or to trigger events. In the single-pulse mode, software controls the level of the EXTSTROBE* signal. A 10 and a 1.2 microsecond clock are available for generating the pulse sequence in the hardware-strobe mode. Refer to the E/M Series device user manual for more detailed information. This functionality is not available in LabVIEW or NI-DAQ. EXTSTROBE* is used for controlling SCXI chassis, and it is not a general-purpose signal. If you want to use or control this signal, you must perform register-level programming.
excitation	Supplying a voltage or current source to energize an active sensor or circuit.
EXT CONV	External control signal to trigger A/D conversions.
EXT INT	External interrupt signal.

F

F	(1) Fahrenheit—a temperature measurement scale; (2) farad—a measurement unit of capacitance.
FIFO	First-in first-out memory buffer—the first data stored is the first data sent to the acceptor. FIFOs are often used on DAQ devices to temporarily store incoming or outgoing data until that data can be retrieved or output.
filtering	A type of signal conditioning that allows you to remove unwanted frequency components from the signal you are trying to measure.
FSR	Full-scale range.
ft	Feet.

G

G	Gain.
gain	The factor by which a signal is amplified, sometimes expressed in decibels.
GND	Ground.

H

Hz	Hertz—cycles per second of a periodic signal; the unit of measure for frequency.

I

I/O	Input/output—the transfer of data to/from a computer system involving communications channels, operator interface devices, and/or data acquisition and control interfaces.
ID	Identifier.
in.	Inch or inches.
input damage level	The highest voltage level that you can apply to the module without damaging it.

L

lowpass filter	A filter that passes signals below a cutoff frequency while blocking signals above that frequency.

M

m	Meters.
MB	Megabytes of memory.
MIO	Multifunction I/O.
MISO	Master-in-slave-out signal.
MOSI	Master-out-slave-in signal
max	Maximum.
min	(1) Minutes; (2) minimum.

multiplex	To route one of many input signals to a single output.
mutliplexed mode	An SCXI operating mode in which analog input channels are multiplexed into one module output so that the cabled E/M Series DAQ device has accessed the module's multiplexed output as well as the outputs of all other multiplexed modules in the chassis.

N

NC	Normally closed, or not connected.
NI-DAQ	The driver software needed in order to use E/M Series DAQ devices and SCXI components.
noise	An undesirable electrical signal—noise comes from external sources such as AC power lines, motors, generators, electrical storms, welders, radio transmitters, and internal sources such as semiconductors, resistors, and capacitors. Noise corrupts signals you are trying to measure.
nonlinearity	For an amplifier, a measure of the maximum output deviation from an ideal linear response in units of percent relative to full scale. The ideal linear response is taken to be a straight line on a plot of measured output voltage to measured input voltage with the ends of the line connecting the extremes of the plot at the full-scale limits.

O

OUT	Output signal.
OUT REF	Output reference signal.
overvoltage protection	Maximum voltage that does not cause hardware damage.

P

passband	The range of input frequencies that are passed to the filter output without attenuation.
pole	A term used to describe the quality of a lowpass filter. In general, the more poles a lowpass filter has, the better it attenuates frequencies beyond the cutoff frequency.
ppm	Parts per million.
PXI	PCI eXtensions for Instrumentation–an open specification that builds on the CompactPCI specification by adding instrumentation-specific features.

R

RMA	Return Material Authorization.
rms	Root mean square—the square root of the average value of the square of the instantaneous signal amplitude; a measure of signal amplitude.
RSVD	Reserved bit, pin, or signal.

S

s	Seconds.
S	Samples.
sample	An instantaneous measurement of a signal, normally using an analog-to-digital converter in an E/M Series DAQ device.
sample rate	The number of samples a system takes over a given time period, usually expressed in samples per second.
scan	One or more analog samples taken at the same time, or nearly the same time. Typically, the number of input samples in a scan is equal to the number of channels in the input group. For example, one scan acquires one new sample from every analog input channel in the group.
SCANCLK	Scan clock signal used to increment to the next channel after each E/M Series DAQ device analog-to-digital conversion.

SCXI	Signal Conditioning eXtensions for Instrumentation—the NI product line for conditioning low-level signals within an external chassis near sensors so only high-level signals are sent to DAQ devices in the noisy PC environment.
SCXIbus	Located in the rear of an SCXI chassis, the SCXIbus is the backplane that connects modules in the same chassis to each other.
sensor	A device that converts a physical phenomenon into an electrical signal.
SER CLK	Serial clock signal used to synchronize digital data transfers over the SER DAT IN and SER DAT OUT lines.
SER DAT IN	Serial data input signal.
SER DAT OUT	Serial data output signal.
signal conditioning	The manipulation of signals to prepare them for digitizing.
Slot 0	Refers to the power supply and control circuitry in the SCXI chassis.
SLOT 0 SEL*	Slot 0 select signal.

U

UL	Underwriters laboratory.

V

V	Volts.
V_{CC}	Positive supply voltage from the PCMCIA bus (usually +5V).
VDC	Volts, direct current.
VI	Virtual instrument—(1) a combination of hardware and/or software elements, typically used with a PC, that has the functionality of a classic stand-alone instrument; (2) a LabVIEW software module (VI), which consists of a front panel user interface and a block diagram program.
virtual channels	Channel names that can be defined outside the application and used without having to perform scaling operations.

V_{IH}	Volts, input high.
V_{IL}	Volts, input low.
V_{in}	Volts in.
V_{OH}	Volts, output high.
V_{OL}	Volts, output low.

W

W	Watts.
working voltage	The highest voltage with respect to ground that should be applied to an input terminal during normal use, normally well under the breakdown voltage for safety margin. Includes both the signal and common-mode voltages.

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